

Brake System

GENERAL

BRAKE SYSTEM

- BRAKE BOOSTER
- BRAKE LINE
- BRAKE PEDAL
- MASTER CYLINDER
- PROPORTIONING VALVE
- FRONT DISC BRAKE
- REAR DISC BRAKE
- REAR DRUM BRAKE

PARKING BRAKE SYSTEM

- PARKING BRAKE
- PARKING BRAKE SWITCH

ABS (ANTI-LOCK BRAKE SYSTEM)

- ANTI-LOCK BRAKING SYSTEM CONTROL MODULE
- ANTI-LOCK BRAKING SYSTEM WHEEL SPEED SENSOR
- G SENSOR

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

- STEERING WHEEL ANGLE SPEED SENSOR
- YAW-RATE SENSOR & G-SENSOR
- MASTER CYLINDER PRESSURE SENSOR
- ESP SWITCH

GENERAL

SPECIFICATIONS EC9CF7DE

Item	Specification
Master cylinder · Type · I.D. mm(in.)(CBS/ABS) · Piston stroke mm(in) · Output port(CBS/ABS) · Fluid level warning sensor	Tandem type 23.8/25.4(0.937/1.0) 30~32(1.18~1.26) 4port/4port Provided
Proportioning valve · Cut-in pressure(Split point) · Decompression ratio	15Kgf / cm ² 0.27:1(2WD) 0.32:1(4WD)
Brake booster · Type · Effective dia. mm(in.) · Boosting ratio	Vacuum 8+9 in 9:1
Front brake(Disc) · Type · Disc O.D. · Disc I.D. · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D.	Floating type with ventilated disc 280 mm 172 mm (6.77 in.) 26 mm 11 mm single piston 60 mm (2.36 in.)
Rear brake(Drum) · Type · Drum I.D. · Brake lining thickness · Clearance adjustment	Leading trailing drum 228.6 mm (9.0 in.) 4.5 mm (0.17 in.) Automatic
Rear brake(Disc) · Type · Disc O.D. (2WD/4WD) · Parking Brake Drum I.D · Disc thickness · Pad thickness · Cylinder type · Cylinder I.D	Floating type with solid disc 262/284 mm (10.31/11.18 in.) 190mm(7.48 in.) 10 mm (0.39 in.) 10 mm (0.39 in.) single piston 34 mm (1.34 in.)
Parking brake · Type · Actuation · Cable arrangement	V type Mechanical brake acting on rear wheels Lever

O.D=Outer Diameter

I.D=Inner Diameter



NOTE

CBS : Conventional Brake System

SPECIFICATION (ABS & TCS)

EF37DD02

PART	ITEM		STANDARD VALUE	REMARK
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor (MGH-25)	·ABS system:ABS & EBD control ·FTCS system:ABS & EBD control (Both Brake and Engine control)
	Type		Motor, valve relay intergrated type	
	Operating voltage		10V~16V(DC)	
	Operating temperature		-40~110°C(-40~230°F)	
	Motor power		180W	
	Pump orifice		Ø0.5mm(0.0197 in.)	
	Accumulator capacity	LPA	MC:3.0cc/MCP3.0cc	LPA:Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front:Ø0.71mm (0.0280 in.) Rear:Ø0.315mm (0.0124in.)	NO valve:4
		Outlet valve(NC)	Front:Ø0.56mm (0.0220 in.) Rear:Ø0.355mm (0.0140 in.)	NC valve:4
	Traction Control valve relief pressure		120bar	With TCS
Warning lamp	Operating voltage		12V	·ABS W/L:ABS failure ·Brake W/L:Parking, brake oil, EBD failure ·TCS W/L:TCS failure
	Current consumption		80mA	
Wheel speed sensor(CBS)	Internal resistance		1385±110Ω	23±5°C
	Output range		15~2000HZ	
	Min. Voltage peak		130mVp.p(15HZ) 200mVp.p(1000HZ)	Max.air gap
	Air gap		0.2~1.3mm (0.0079~0.0512 in.)	
Active wheel speed sensor(ABS)	Supply voltage		DC 12V	
	Output current low		5.9~8.4mA	Typ.7mA
	Output current High		11.8~16.8mA	Typ.14mA
	Frequency range		1~2000HZ	
	Air gap		0.5~1.5mm (0.019~0.0591 in.)	
	Tone wheel		48 teeth	

SPECIFICATION(ESP)

PART	ITEM		STANDARD VALUE	REMARK
HECU(Hydraulic and Electronic Control Unit)	System		4 channel 4 sensor(MGH-25)	·Total control(ABS, EBD, TCS, ESP) ·CAN communication with ECU & TCU
	Type		Motor, valve relay intergrated type	
	Operating voltage		10V~16V(DC)	
	Operating temperature		-40~110°C(-40~230°F)	
	Motor power		250W	
	Pump orifice		Ø0.5mm(0.0197 in.)	
	Accumulator capacity	LPA	MCS: 3.0cc/MCP:3.0cc	LPA:Low pressure accumulator
		HPA	0.13cc	HPA:High pressure accumulator
	Valve	Inlet valve(NO)	Front:Ø0.71mm(0.0280 in.) Rear:Ø0.315mm(0.0124 in.)	NO valve:4
		Outlet valve(NC)	Front:Ø0.56mm(0.0220 in.) Rear:Ø0.355mm(0.0140 in.)	NC valve:4
	Traction Control valve relief pressure		120~150bar	
Warning lamp	Operating voltage		12V	·ESP Operating Lamp ·ESP Warning Lamp
	Current consumption		80mA	
Active wheel speed sensor	Supply voltage		DC12V	
	Output current low		5.9~8.4mA	
	Output current high		11.8~16.8mA	
	Frequency range		1~2000HZ	
	Airgap		0.5~1.5mm	
Steering Wheel Angle Sensor	Operating Voltage		9V~16V	
	Current Consumption		Max 100mA	
	High Output voltage		3.0V~4.1V	
	Low output voltage		1.3V~2.0V	
	Operating Angular velocity		Max 1500°/sec	
Yaw-rate & G sensor	Operating Voltage		4.75V~5.25V	
	Current Consumption		Max. 65mA	
	Output Voltage		0.5V~4.5V	
	Yaw Sensor Operating Range		±75° /s	
	G Sensor Operating Range		±1.5G	
	Nominal Offset		2.5V	

GENERAL

BR -5

PART	ITEM	STANDARD VALUE	REMARK
Master Pressure Sensor	Operating Voltage	4.75V~5.25V	
	Current Consumption	Max. 15mA	
	Output Voltage Range	0.5V~4.4V	
	Output Pressure Range	0~200bar	
	Max Pressure	350 bar	
	Nominal Offset	0.5V	

SERVICE STANDARD

E650FA6B

	Standard value	Service limit
Brake pedal height	163mm(0.209in.)	
Brake pedal full stroke	128 mm (5.04 in.)	
Brake pedal free play	3~8mm(0.11~0.31in.)	
Brake pedal to floorboard clearance	82mm(3.23in.)	
Stop lamp switch outer case to pedal stopper clearance	0.5~1.0 mm (0.02~0.04 in.)	
Booster push rod to master cylinder piston clearance	0 (at 500 mmHg vacuum)	
Parking brake lever stroke when lever assembly is pulled with 196N (20Kgf, 44lb force)	7~8 clicks	
Front disc brake pad thickness	11 mm (0.43 in.)	2 mm (0.079 in.)
Front disc thickness (minimum)	26 mm (10.24 in.)	24.4 mm (0.961in.)
Front disc runout		Max.0.03 mm (0.001in.)
Front disc thickness variation		Max.0.005 mm (0.0002in.)
Rear drum brake lining thickness	4.5 mm (0.177 in.)	1.0 mm (0.039 in.)
Rear drum brake drum I.D.	228.6 mm (9 in.)	Max.230.6mm (9.079 in.)
Rear disc brake pad thickness	10 mm (0.394 in.)	2 mm (0.079 in.)
Rear disc brake disc thickness	10 mm (0.394 in.)	8 mm (0.315 in.)
Rear disc runout		Max.0.03mm (0.001in.)
Rear disc thickness variation		Max.0.005 mm (0.0002in.)

TIGHTENING TORQUE

	Nm	Kgf·cm	lbf·ft
Proportioning valve to master cylinder	35~55	350~550	25.8~40.6
Master cylinder to booster mounting nut	8~12	80~120	5.9~8.9
Brake booster mounting nut	13~16	130~160	9.6~11.8
Brake booster vacuum hose fitting to surge tank	15~18	150~180	11.1~13.3
Bleeder screw	7~13	70~130	5.2~9.6
Brake tube nut, brake hose	13~17	130~170	9.6~12.5
Caliper assembly to knuckle	80~100	800~1000	59.0~73.8
Brake hose to front caliper	25~30	250~300	18.4~22.1
Brake hub flange nut	200~260	2000~2600	147.5~191.8
Push rod locking nut	16~22	160~220	11.8~16.2
Caliper guide rod bolt	22~32	220~320	16.2~23.6

TIGHTENING TORQUE (ABS & TCS)

ITEM	N·m	kgf·cm	lbf·ft
Active wheel speed sensor mounting bolt on the brake plate	8~9	80~90	5.6~6.6
·Front	8~9	80~90	5.6~6.6
·Rear			
Hydraulic & electronic control unit mounting bolt	8~10	80~100	5.6~6.9
Hydraulic & electronic control unit mounting bracket bolt	17~26	170~260	12~19
Brake tubes nut	12~16	120~160	9~12
Air bleeder screw	7~13	70~130	5~9.6

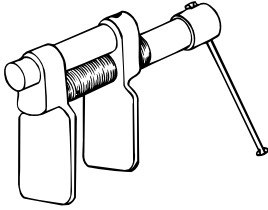
TIGHTENING TORQUE (ESP)

ITEM	N·m	kgf·cm	lbf·ft
Yaw rate & lateral acceleration sensor Nut	4~6	40~60	2.9~4.4
Steering wheel nut	40~50	400~500	28.9~36.9
Master cylinder pressure sensor	22.4~26.5	224~265	16.5~19.5

GENERAL

BR -7

SPECIAL TOOL E389A1A4

TOOL(Number and Name)	ILLUSTRATION	USE
09581-11000 Piston expander	 EJDA043A	Spreading the front disc brake piston

TROUBLESHOOTING

E83FD66A

PROBLEM SYMPTOMS TABLE

Use the table below to help you find the cause of the problem. The numbers indicate the priority of the like cause of the problem. Check each part in order. If necessary, replace these parts

Symptom	Suspect Area	Reference
Lower pedal or spongy pedal	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Piston seals (Worn or damaged) 4. Rear brake shoe clearance(Out of adjustment) 5. Master cylinder (Faulty)	repair air-bleed replace adjust replace
Brake drag	1. Brake pedal freeplay (Minimum) 2. Parking brake lever travel (Out of adjustment) 3. Parking brake wire (Sticking) 4. Rear brake shoe clearance(Out of adjustment) 5. Pad or lining (Cracked or distorted) 6. Piston (Stuck) 7. Piston (Frozen) 8. Anchor or Return spring (Faulty) 9. Booster system (Vacuum leaks) 10. Master cylinder (Faulty)	adjust adjust repair adjust replace replace replace replace repair replace
Brake pull	1. Piston (Sticking) 2. Pad or lining (Oily) 3. Piston (Frozen) 4. Disc (Scored) 5. Pad or lining (Cracked or distorted)	replace replace replace replace replace
Hard pedal but brake inefficient	1. Brake system (Fluid leaks) 2. Brake system (Air in) 3. Pad or lining (Worn) 4. Pad or lining (Cracked or distorted) 5. Rear brake shoe clearance(Out of adjustment) 6. Pad or lining (Oily) 7. Pad or lining (Glazed) 8. Disc (Scored) 9. Booster system (Vacuum leaks)	repair air-bleed replace replace adjust adjust replace replace repair
Noise from brake	1. Pad or lining (Cracked or distorted) 2. Installation bolt (Loosen) 3. Disc (Scored) 4. Sliding pin (Worn) 5. Pad or lining (Dirty) 6. Pad or lining (Glazed) 7. Anchor or Return spring (Faulty) 8. Brake pad shim (Damage) 9. Shoe hold-down spring (Damage)	replace adjust replace replace clean replace replace replace replace

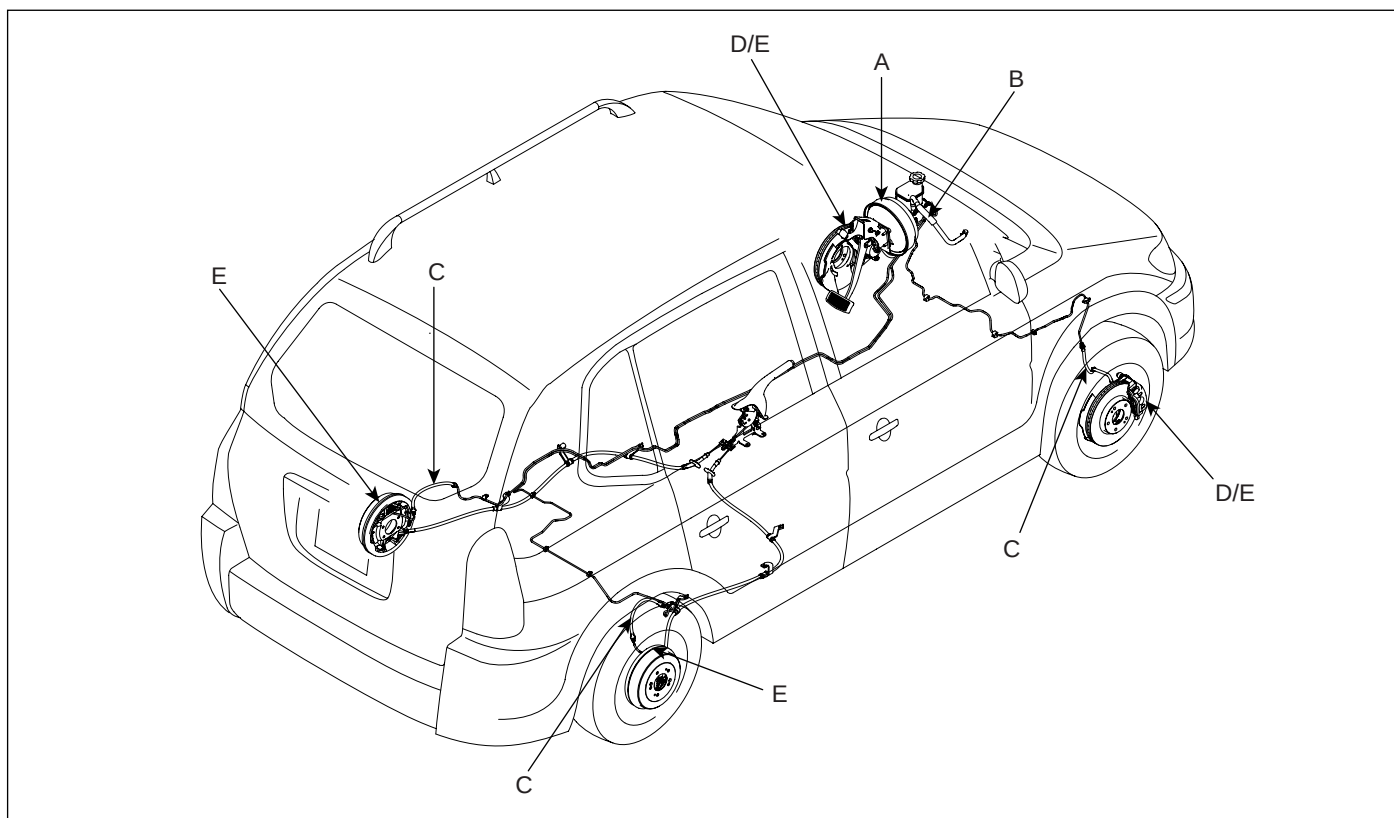
BRAKE SYSTEM

OPERATION AND LEAKAGE

CHECK EEBD2FE0

CHECK ALL OF THE FOLLOWING ITEMS:

Component	Procedure
Brake Booster (A)	Check brake operation by applying the brakes during a test drive. If the brakes do not work properly, check the brake booster. Replace the brake booster as an assembly if it does not work properly or if there are signs of leakage.
Piston cup and pressure cup inspection (B)	• Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. Replace the master cylinder as an assembly if the pedal does not work properly or if there is damage or signs of fluid leakage. • Check for a difference in brake pedal stroke between quick and slow brake applications. Replace the master cylinder if there is a difference in pedal stroke.
Brake hoses (C)	Look for damage or signs of fluid leakage. Replace the brake hose with a new one if it is damaged or leaking.
Caliper piston seal and piston boots (D)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, disassemble and inspect the brake caliper. Replace the boots and seals with new ones whenever the brake caliper is disassembled.
Wheel cylinder piston cup and dust cover (E)	Check brake operation by applying the brakes. Look for damage or signs of fluid leakage. If the pedal does not work properly, the brakes drag, or there is damage or signs of fluid leakage, replace the wheel cylinder.

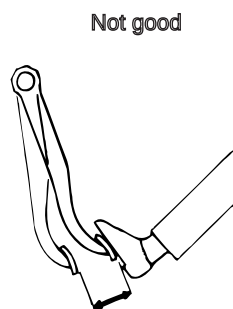
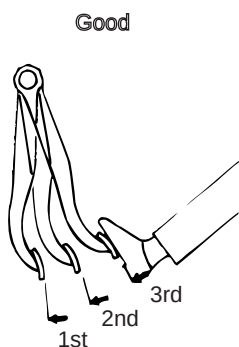


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BRAKE BOOSTER OPERATING TEST

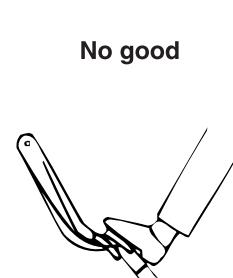
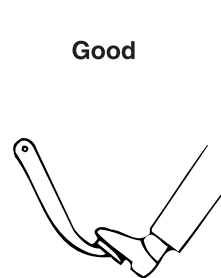
For simple checking of the brake booster operation, carry out the following tests

1. Run the engine for one or two minutes, and then stop it. If the pedal depresses fully the first time but gradually becomes higher when depressed succeeding times, the booster is operating properly, if the pedal height remains unchanged, the booster is defective.



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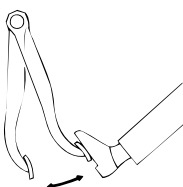
3. With the engine running, step on the brake pedal and then stop the engine. Hold the pedal depressed for 30 seconds. If the pedal height does not change, the booster is in good condition, if the pedal rises, the booster is defective. If the above three tests are okay, the booster performance can be determined as good. Even if one of the above three tests is not okay, check the check valve, vacuum hose and booster for defect.



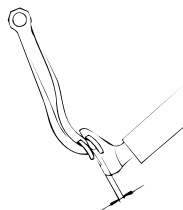
EGGE700C

2. With the engine stopped, step on the brake pedal several times. Then step on the brake pedal and start the engine. If the pedal moves downward slightly, the booster is in good condition. If there is no change, the booster is defective.

When engine is stopped



When engine is started



EGGB700B

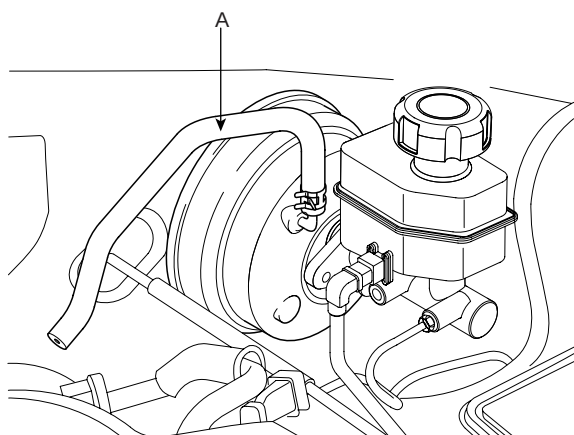
BRAKE SYSTEM

BR -11

VACUUM HOSE (CHECK VALVE)

INSPECTION

1. Disconnect the brake booster vacuum hose (check valve built in) (A) at the booster (B).
2. Start the engine and let it idle. There should be vacuum available. If no vacuum is available, the check valve is not working properly. Replace the brake booster vacuum hose and check valve and retest.

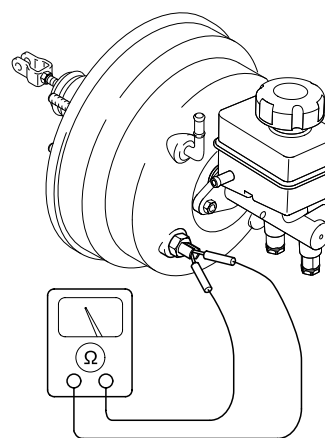


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VACUUM SWITCH (ONLY DIESEL ENGINE)

For simple checking of the vacuum switch operation, carry out the following tests:

1. Block the tire with a suitable block.
2. Release the parking brake and check the brake fluid level.
3. With the engine stopped, step on the brake pedal more than 20 times.
4. When IG ON, check whether parking brake pedal warning lamp turn on.
5. If the parking brake warning lamp is not off, stop the engine, and step on the brake pedal more than 20 times.
6. Check the continuity between terminals of the vacuum switch, after disconnecting the connector from the vacuum switch.
7. If there is no continuity, replace vacuum switch.



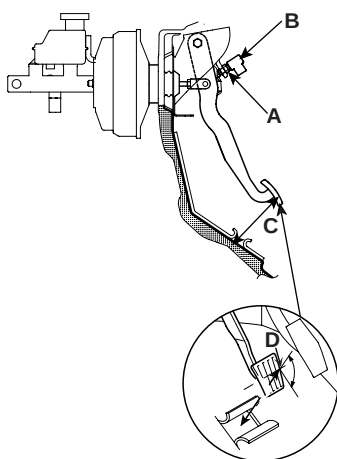
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BRAKE PEDAL BRAKE SWITCH ADJUSTMENT

PEDAL HEIGHT

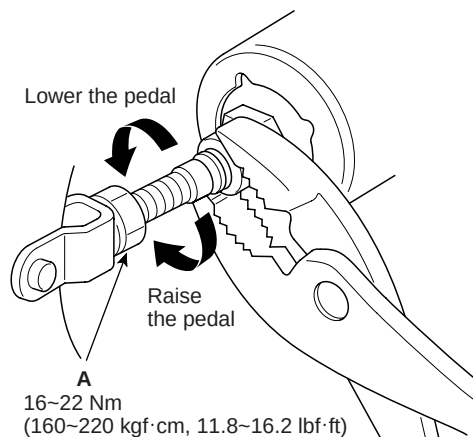
1. Disconnect the brake switch connector, loosen the brake switch locknut (A), and brake off the brake switch (B) until it is no longer touching the brake pedal.
2. Lift up the carpet. At the insulator cutout, measure the pedal height (C) from the middle of the left-side center of the pedal pad (D).

Standard pedal height(with carpet removed):
163mm(6.41 in.)



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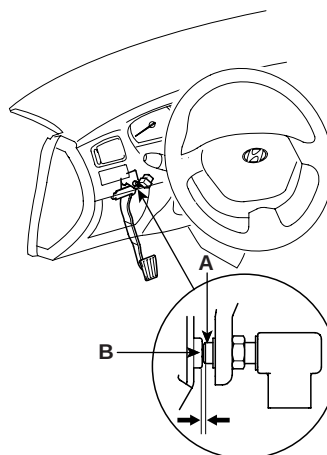
3. Loosen the pushrod locknut (A), and screw the pushrod in or out with pliers until the standard pedal height from the floor is reached. After adjustment, tighten the locknut firmly. Do not adjust the pedal height with the pushrod depressed.



EJKE001B

BRAKE SWITCH CLEARANCE

Screw in the brake switch until its plunger is fully depressed (threded end (A) touching the pad (B) on the pedal arm) then brake off the switch 3/4 turn to make 0.5~1.0mm(0.0197~0.0394 in.) of clearance between the brake switch connector. Make sure that the brake lights go off when the pedal is released.



EJKE001C

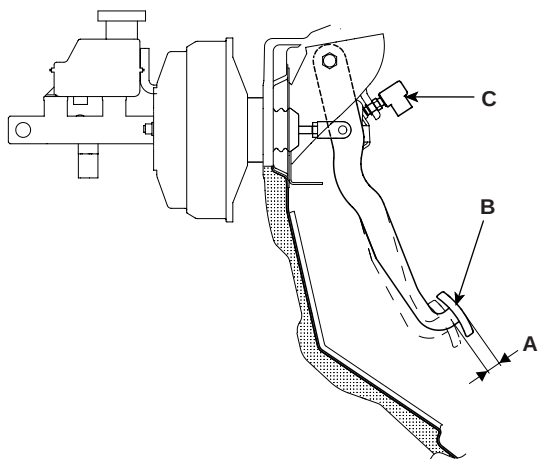
BRAKE SYSTEM

BR -13

PEDAL FREE PLAY

1. With the engine off, inspect the pedal free play (A) on the pedal pad (B) by pushing the pedal by hand.

Free play: 3~8mm (0.11~0.31 in.)



EJKE001D

2. If the pedal free play is out of specification, adjust the brake switch (C). If the pedal free play is insufficient, it may result in brake drag.

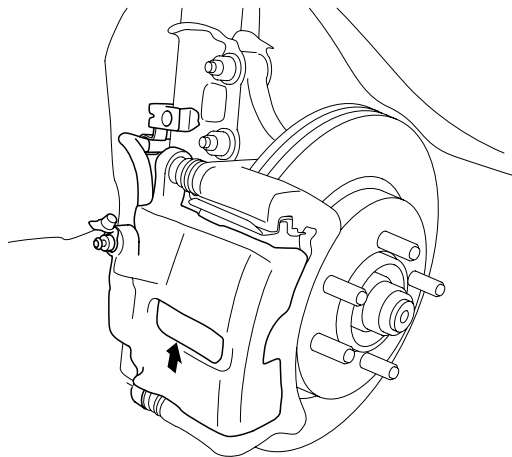
INSPECTION OF FRONT DISC BRAKE PAD

1. Check the brake pad thickness through the caliper body inspection hole

Pad thickness

Standard value : 11.0 mm (0.43 in.)

Service limit : 2.0 mm (0.0787 in.)



KJQE050H



CAUTION

- If the pad lining thickness is out of specification, left and right pads must be replaced as a complete set.
- When the thickness difference between the left pad right pad is large, check the sliding condition of the piston and the guide rod.

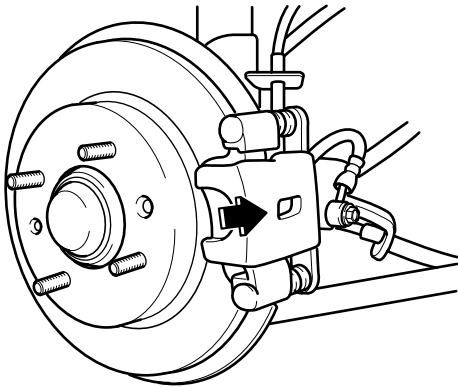
INSPECTION OF REAR DISC BRAKE PAD

1. Check the rear disk brake pad thickness through the caliper body inspection hole.

Pad thickness

Standard value : 10.0 mm (0.39 in.)

Service limit : 2.0 mm (0.0787 in.)



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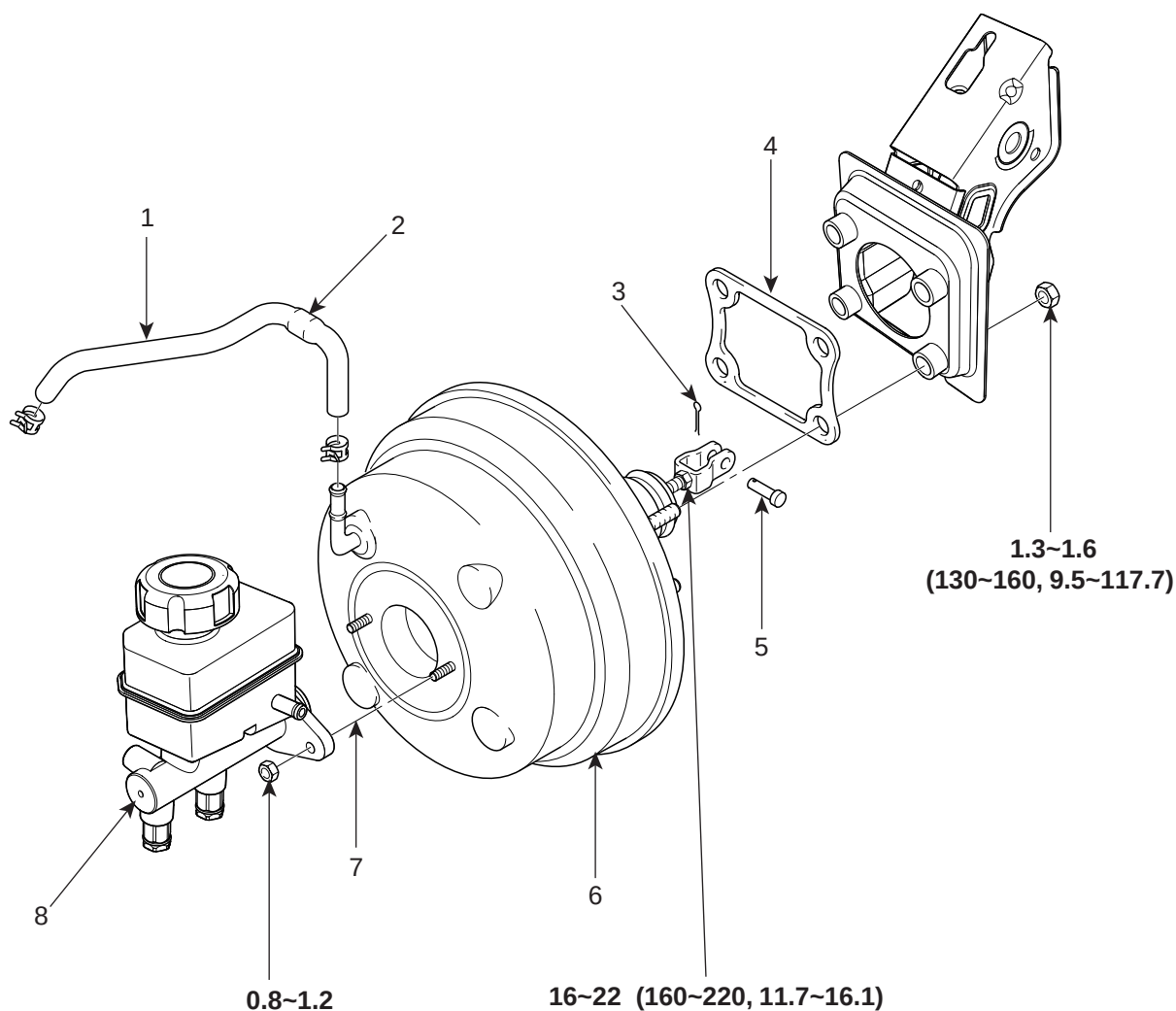


CAUTION

- *If the pad thickness is out of specification, left and right pads must be replaced as a complete set.*
- *When the thickness difference between the left pad and right pad is large, check the sliding condition of the piston and the guide rod.*

BRAKE BOOSTER

COMPONENTS E01DDCBE



TORQUE : N·m (kgf·cm, lbf·ft)

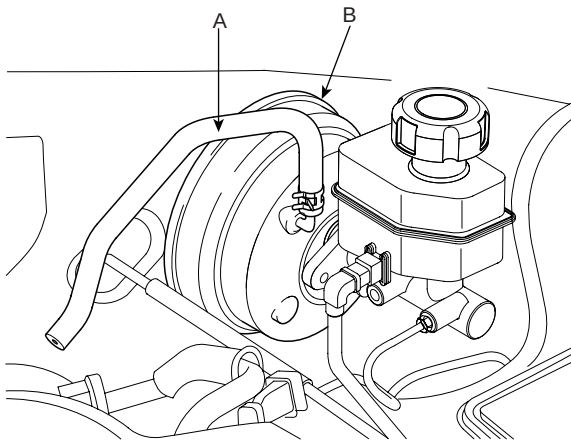
- 1. Vacuum hose
- 2. Check valve
- 3. Snap pin
- 4. Seal

- 5. Clevis pin
- 6. Brake booster
- 7. Vacuum switch
- 8. Master cylinder

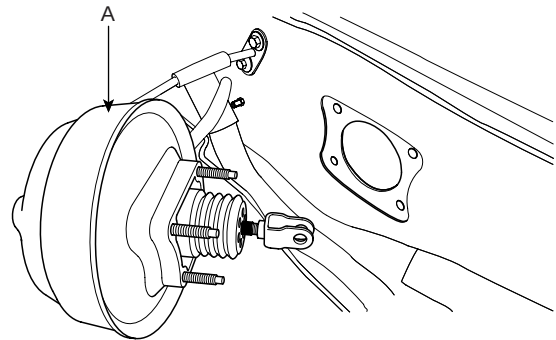
REMOVAL

EB3B6720

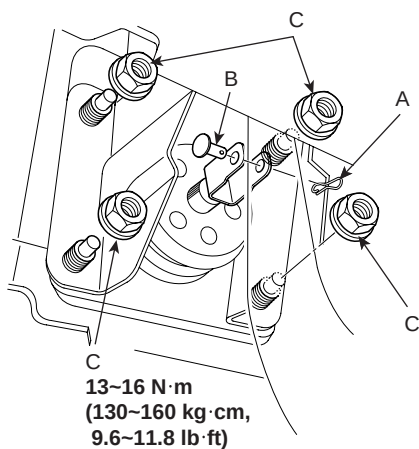
1. Remove the master cylinder.
2. Disconnect the vacuum hose (A) from the brake booster (B).
3. Remove the snap pin (A) and pin (B).
4. Remove the four booster mounting nuts (C).
5. Remove the brake booster (A).



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EJKE305D



EJQE040A

BRAKE SYSTEM

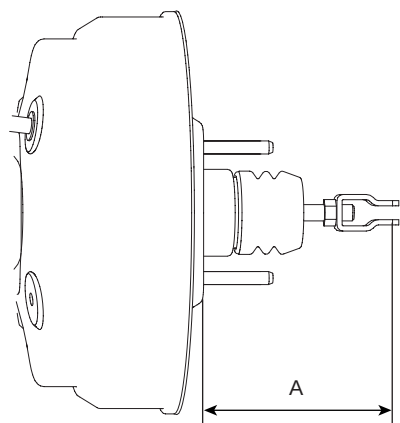
BR -17

INSTALLATION

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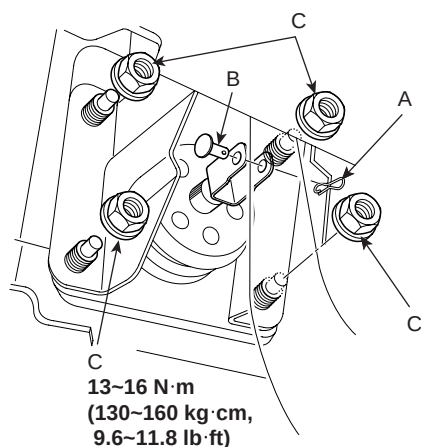
1. Adjust push rod length of the booster, and then install the seal on the booster assembly.

Standard length (A): 106 ± 0.5 mm (4.173 ± 0.019 in.)



KJQE050C

2. Insert the booster and tighten the nuts (C).



EJQE040A

3. Connect the booster push rod and brake pedal with a pin (B) and install a snap pin (A) to the pin (B).



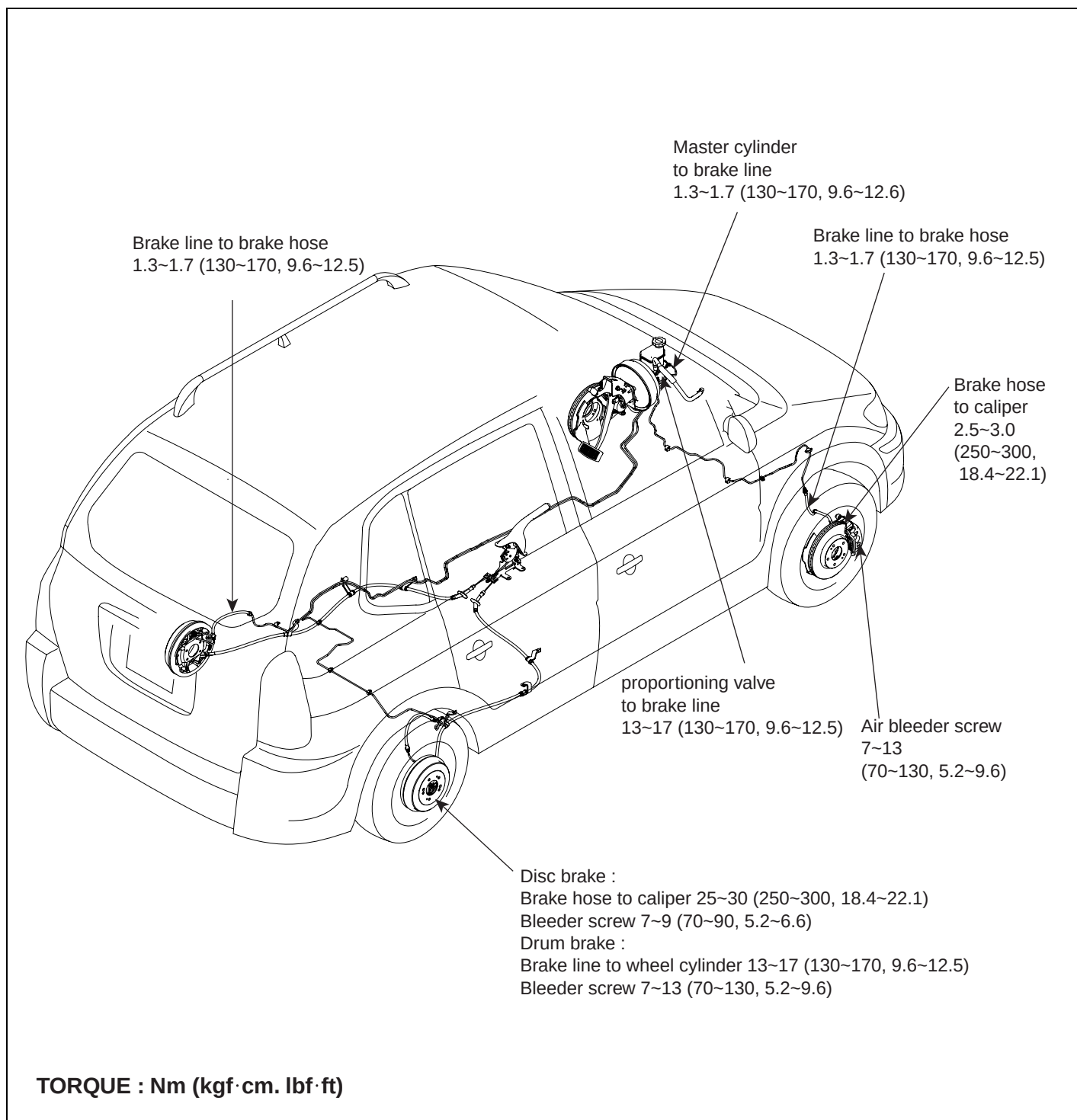
CAUTION

Grease the pin before installing the snap pin.
Always use a new snap pin.

4. Install the master cylinder.
5. Connect the vacuum hose to the brake booster.
6. After filling the brake reservoir with brake fluid, bleed the system.
7. Check for fluid leakage.
8. Check and adjust the brake pedal for proper operation.

BRAKE LINE

COMPONENT E1DEBB77



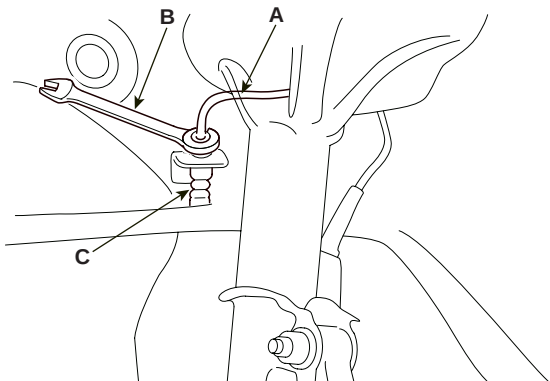
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BRAKE SYSTEM

BR -19

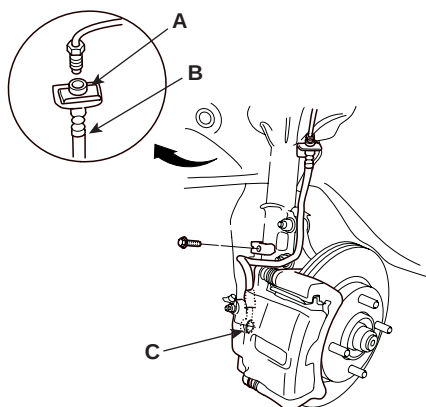
REMOVAL E9ABCF3D

1. Disconnect the brake hose(C) from the brake line(A) using a 10mm flare-nut wrench(B).



ARJE050A

2. Remove the brake hose clip(A) from the brake hose(B).

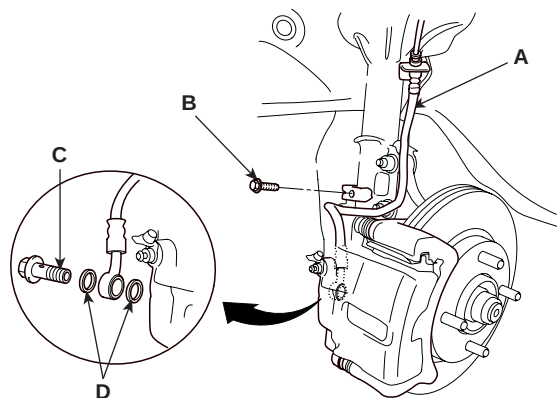


ARJE050B

3. Remove the connector bolt from the caliper(C), and disconnect the brake hose from the caliper.

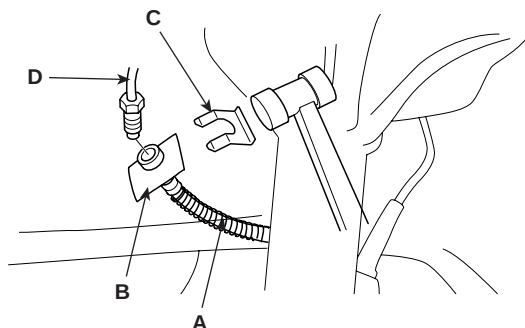
INSTALLATION E0EDD60A

1. Install the brake hose(A) on the knuckle with 12mm flange bolt (B) first, then connect the brake hose to the caliper with the connector bolt (C) and new sealing washers (D).



ARJE050C

2. Install the brake hose (A) on the upper brake hose bracket (B) with a new brake hose clip (C).



ARJE050D

3. Connect the brake hose (D) to the brake line.
4. After installing the brake hose, bleed the brake system.

INSPECTION

EDF2BFC4

- Check the brake tubes for cracks, crimps and corrosion.
- Check the brake hoses for cracks, damaged and oil leakage.
- Check the brake tube flare nuts for damage and oil leakage.

BRAKE SYSTEM BLEEDING

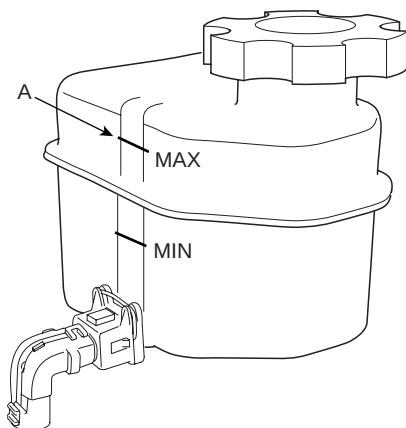
E0D9E7DB



NOTE

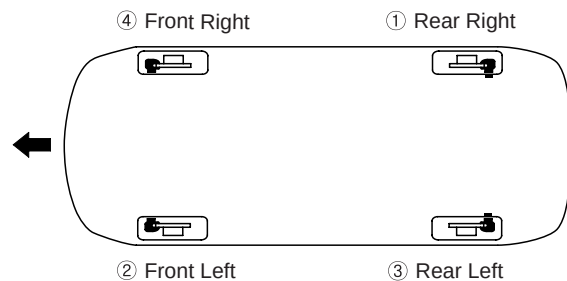
- Do not reuse the drained fluid.
- Always use Genuine DOT3 or DOT 4 Brake Fluid. Using a non-Genuine DOT or 4 brake fluid can cause corrosion and decrease the life of the system.
- Make sure no dirt or other foreign matter is allowed to contaminate the brake fluid.
- Do not spill brake fluid on the vehicle, it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.
- The reservoir on the master cylinder must be at the MAX (upper) level mark at the start of bleeding procedure and checked after bleeding each brake caliper. Add fluid as required.

1. Make sure the brake fluid in the reservoir is at the MAX (upper) level line (A).



EJQE003A

2. Have someone slowly pump the brake pedal several times, then apply pressure.
3. Loosen the right-rear brake bleed screw to allow air to escape from the system. Then tighten the bleed screw securely.
4. Repeat the procedure for wheel in the sequence shown below until air bubbles no longer appear in the fluid.
5. Refill the master cylinder reservoir to MAX(upper) level line.



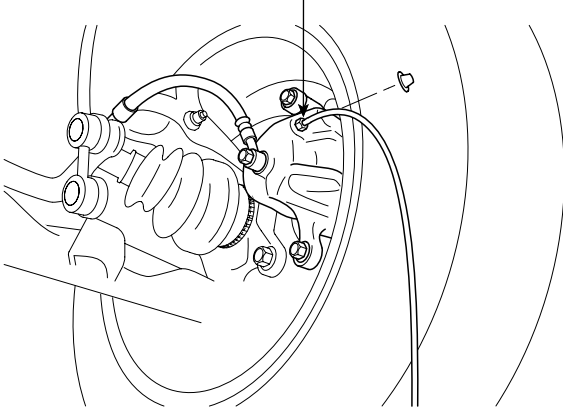
EJKE003B

BRAKE SYSTEM

BR -21

FRONT DISC BRAKE

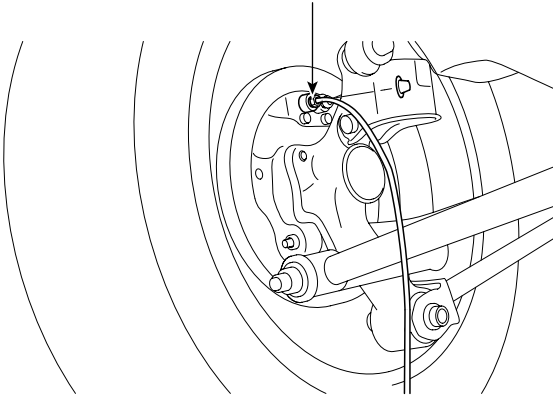
7~13 Nm (70~130 kgf·cm, 5.2~9.6 lbf·ft)



EJKE003C

REAR DRUM BRAKE

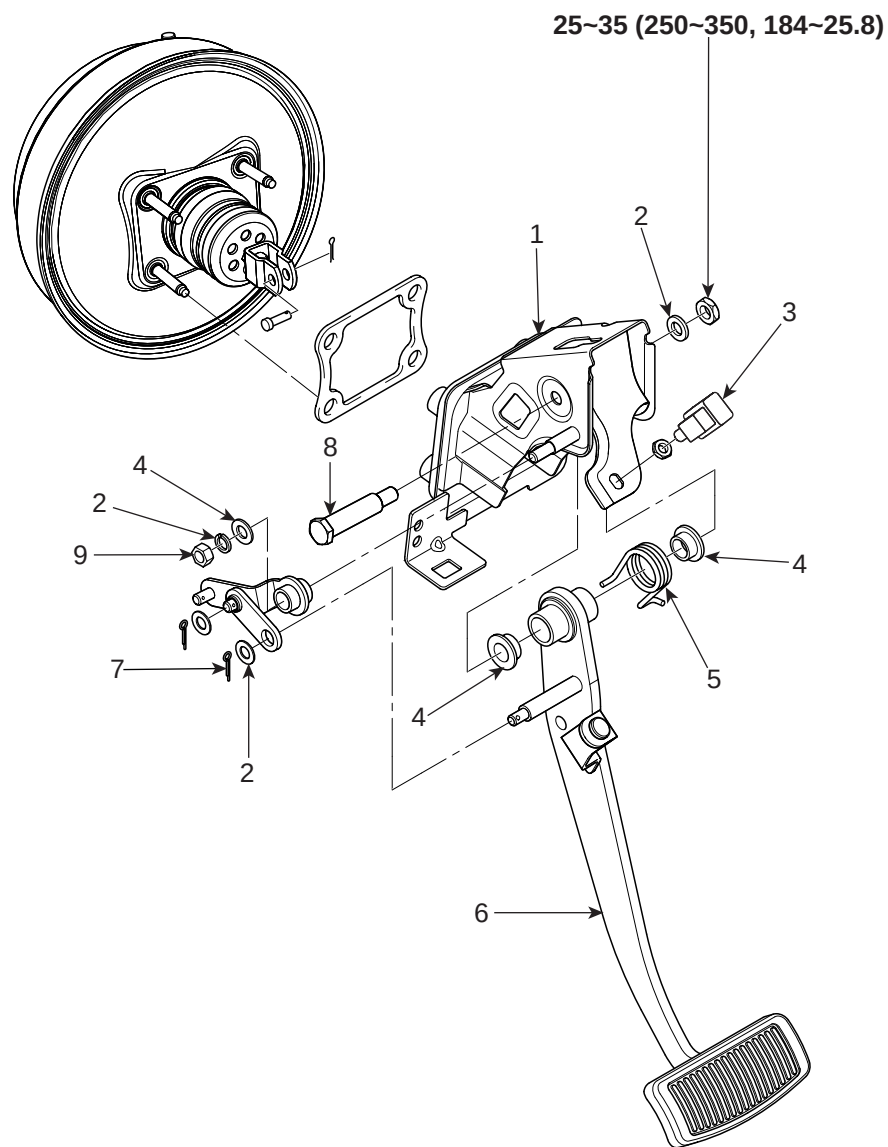
7~13 Nm (70~130 kgf·cm, 5.2~9.6 lbf·ft)



EJKE003E

BRAKE PEDAL

COMPONENTS EE8D1AD9



TORQUE : Nm (Kgf·cm, lbf·ft)

- | | |
|----------------------------|----------------|
| 1. Member assembly bracket | 6. Brake pedal |
| 2. Washer | 7. Snap pin |
| 3. Stop lamp switch | 8. Bolt |
| 4. Bushing | 9. Nut |
| 5. Return spring | |

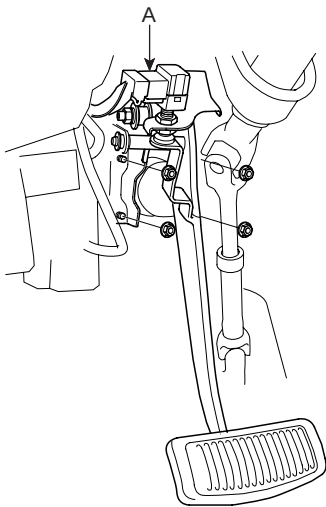
LJIF500B

BRAKE SYSTEM

BR -23

REMOVAL EEBFC7ED

1. Remove the lower crash pad.(reference to BD-"crash pad")
2. Pull down steering column shaft after removing 4 bolts.
3. Remove the stop lamp switch connector (A).
4. Remove the shift lock cable (A/T).



KJQE010A

5. Remove the pin and snap pin.
6. Loosen the brake pedal member assembly mounting nuts and then remove the brake pedal assembly.

INSTALLATION E9DBF41B

1. Installation is the reverse of removal.

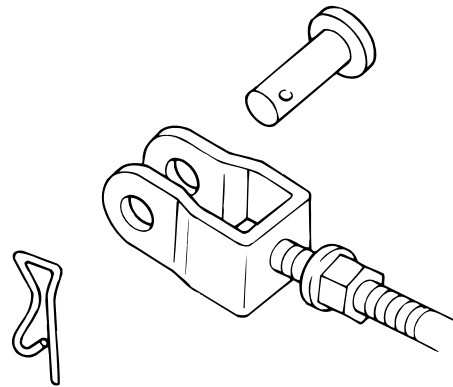


CAUTION

Coat the inner surface of the bushings with the specified grease.

Specified grease:Chassis grease MS 511-3

2. Before inserting the pin, apply the specified grease to the joint pin.



EJQE008R

3. Install the nuts with specified torque, when installing the brake pedal.

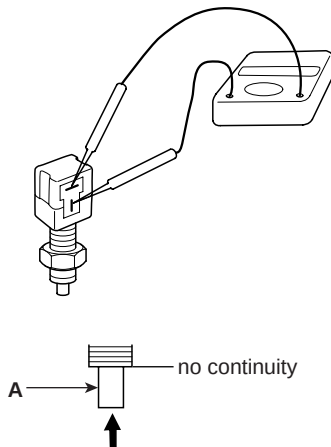
TORQUE : Nm(kgf·cm,lbf·ft); 13~16(130~160, 9.6~11.8)

4. Adjust the brake pedal height and free play.
5. Install the stop lamp switch.

INSPECTION

EB806F88

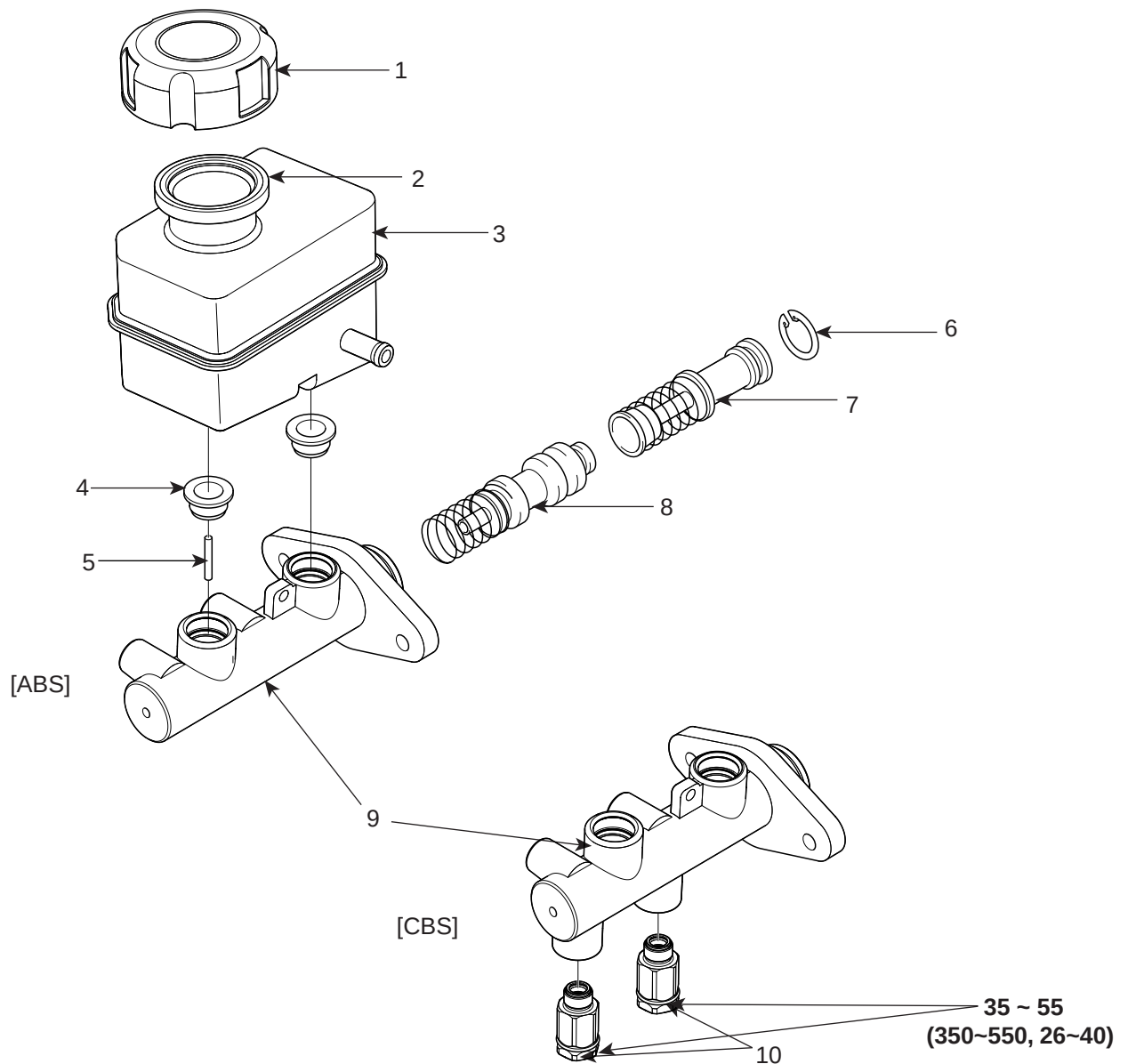
1. Check the bushing for wear.
2. Check the brake pedal for bending or twisting.
3. Check the brake pedal return spring for damage.
4. Check the stop lamp switch
 - 1) Connect a circuit tester to the connector (1-2terminals) of stop lamp switch, and check whether or not there is continuity when the plunger of the stop lamp switch is pushed in and when it is released.
 - 2) The stop lamp switch is in good condition if there is no continuity when plunger is pushed.



EJQE020D

MASTER CYLINDER

COMPONENTS E863CC4C



TORQUE : Nm (Kgf·cm, lbf·ft)

- 1. Reservoir cap
- 2. Brake fluid filter
- 3. Reservoir
- 4. Grommet
- 5. Cylinder pin

- 6. Retainer
- 7. Primary piston assembly
- 8. Secondary piston assembly
- 9. Master cylinder body
- 10. Proportioning valve

LJIF500C

REMOVAL

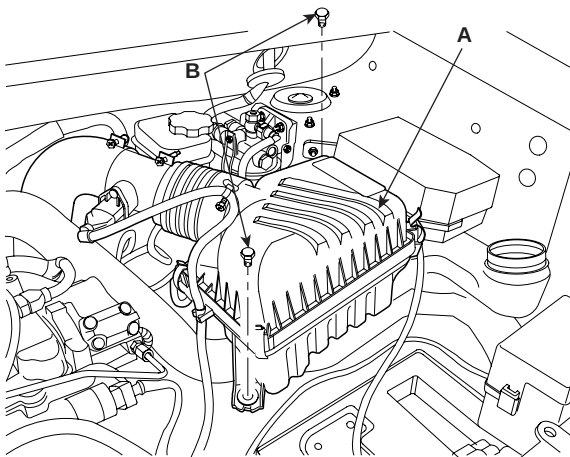
EB4F74BA



NOTE

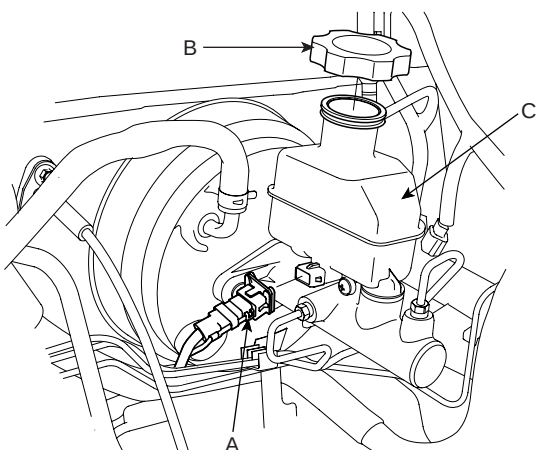
Do not spill brake fluid on the vehicle; it may damage the paint; if brake fluid does contact the paint, wash it off immediately with water.

1. Remove air cleaner mounting bolts (B) from the air cleaner mounting bracket and air cleaner body (A).



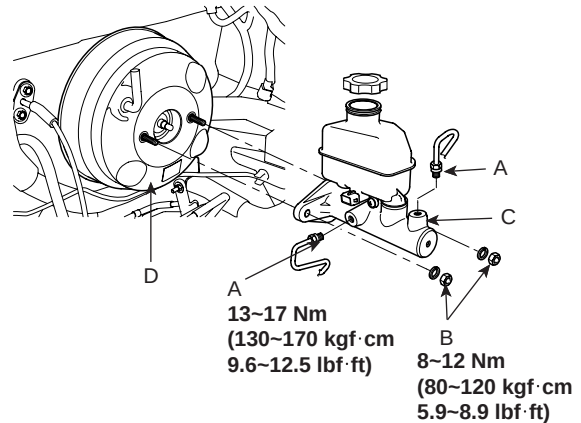
KJQE050M

2. Disconnect the brake fluid level switch connectors (A), and remove the reservoir cap (B).



EJKE200F

3. Remove the brake fluid from the master cylinder reservoir (C) with a syringe.
4. Disconnect the brake lines (A) from the master cylinder. To prevent spills, cover the hose joints with rags or shop towels.



LJIF500D

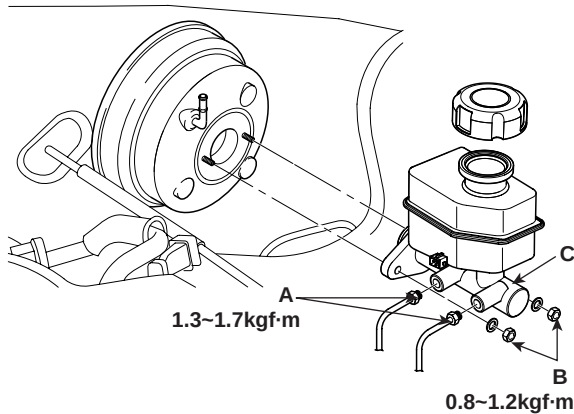
5. Remove the master cylinder mounting nuts (B) and washers.
6. Remove the master cylinder (C) from the brake booster (D). Be careful not to bend or damage the brake lines when removing the master cylinder.

BRAKE SYSTEM

BR -27

INSTALLATION EA0856E9

1. Install the master cylinder on the brake booster with 2 nuts.
2. Connect 2 brake tubes and the brake fluid level sensor connector.

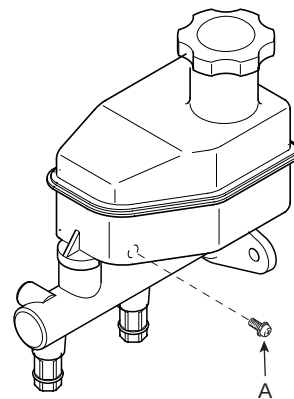


KJQE050F

3. Fill the brake reservoir with the brake fluid and bleed the brake system.

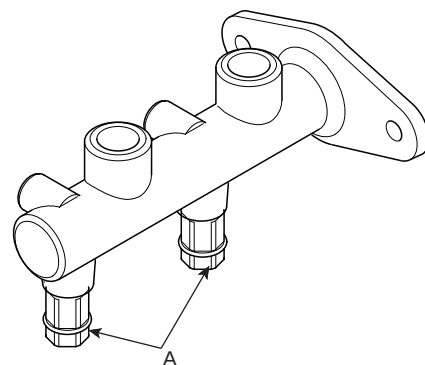
DISASSEMBLY E67A41C6

1. Remove the reservoir cap and drain the brake fluid into a suitable container.
2. Remove the fluid level sensor.
3. Remove the reservoir from the master cylinder, after remove mounting screw (A).



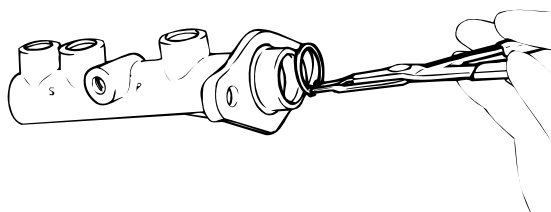
EGGE700D

4. Remove the proportioning valves (A) - CBS only.



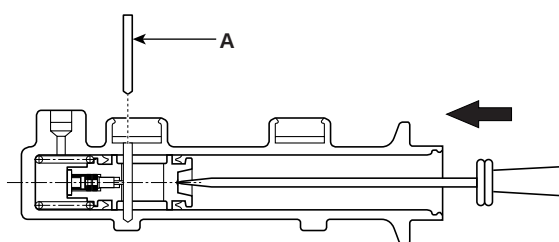
EGGE700E

5. Remove the retainer ring by using the snap ring pliers then remove the primary piston assembly.



EJA9009C

6. Remove the pin with the secondary piston pushed completely using a screwdriver. Remove the secondary piston assembly.



KJQE014B



NOTE

Do not disassemble the primary and secondary piston assembly.

INSPECTION

E5A63A6C

1. Check the master cylinder bore for rust or scratch.
2. Check the master cylinder for wear or damage. If necessary, clean or replace the cylinder.



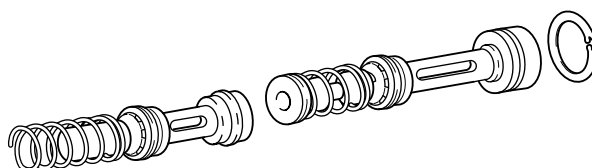
CAUTION

- If the cylinder bore is damaged, replace the master cylinder assembly.
- Wash the contaminated parts in alcohol.

REASSEMBLY

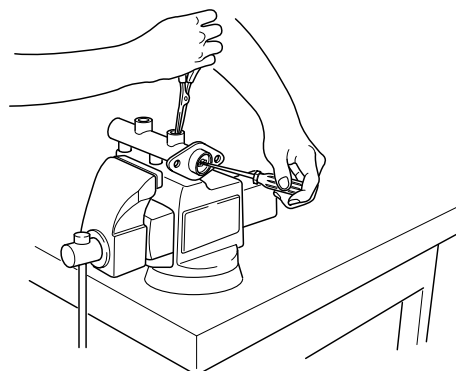
E8BFCD6A6

1. Apply genuine brake fluid to the rubber parts of the cylinder kit and grommets.
2. Carefully insert the springs and pistons in the proper direction.



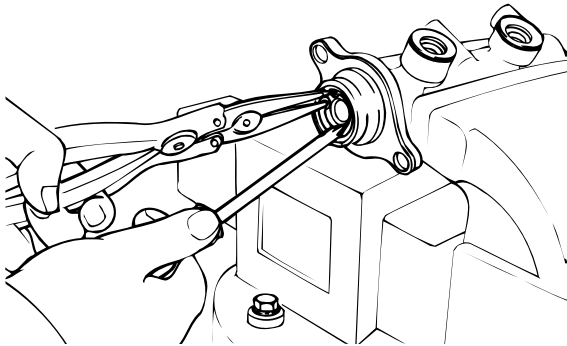
KFW8016A

3. Press the piston with a screwdriver and install the cylinder pin.



EGGE700F

4. Press the piston with a screwdriver and install the retainer ring.



EGGE700G

5. Mount two grommets.
6. Install the reservoir on the cylinder.

Tightening torque : 1.5~3.0 N·m(15~30kg·cm,
1.2~2.1 lbf·ft)

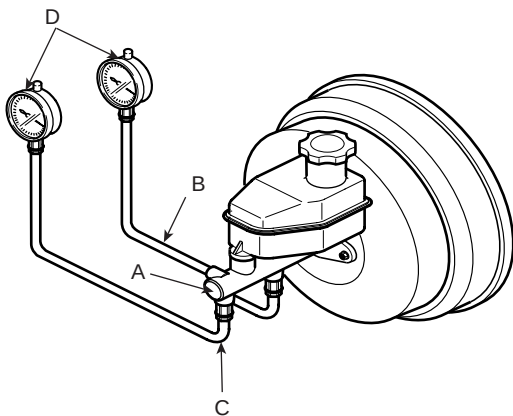
PROPORTIONING VALVE

DESCRIPTION EAE8BE2E

Do not disassemble the proportioning valve. The proportioning valve makes the ideal distribution of fluid pressure to the front and rear brakes to prevent the brakes from skidding in the event of rear wheel lock up and to obtain a higher brake efficiency within the range of service brake application.

INSPECTION E2ED4D75

1. Remove the front brake tube (B) and rear brake tube (C) from the master cylinder (A).
2. Connect two pressure gauges (D); one to the output valve of the front (B) and rear (C) brake.

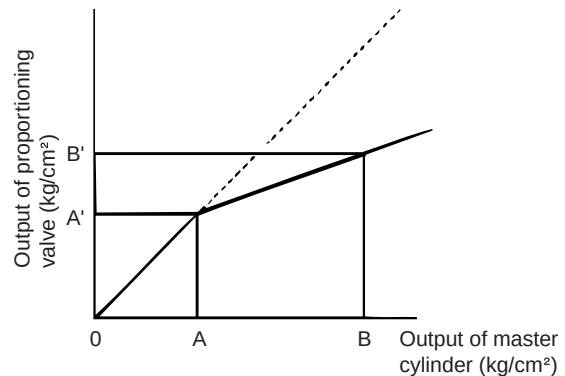


EGGE700H

NOTE

Be sure to bleed the system after connecting the pressure gauges.

3. With the brake applied, measure the front pressure and the rear pressure.
If the measured pressures are within the specified range as illustrated, the proportioning valve is good.



EGGE700I

4. Reconnect the brake lines in their original positions and bleed the system.

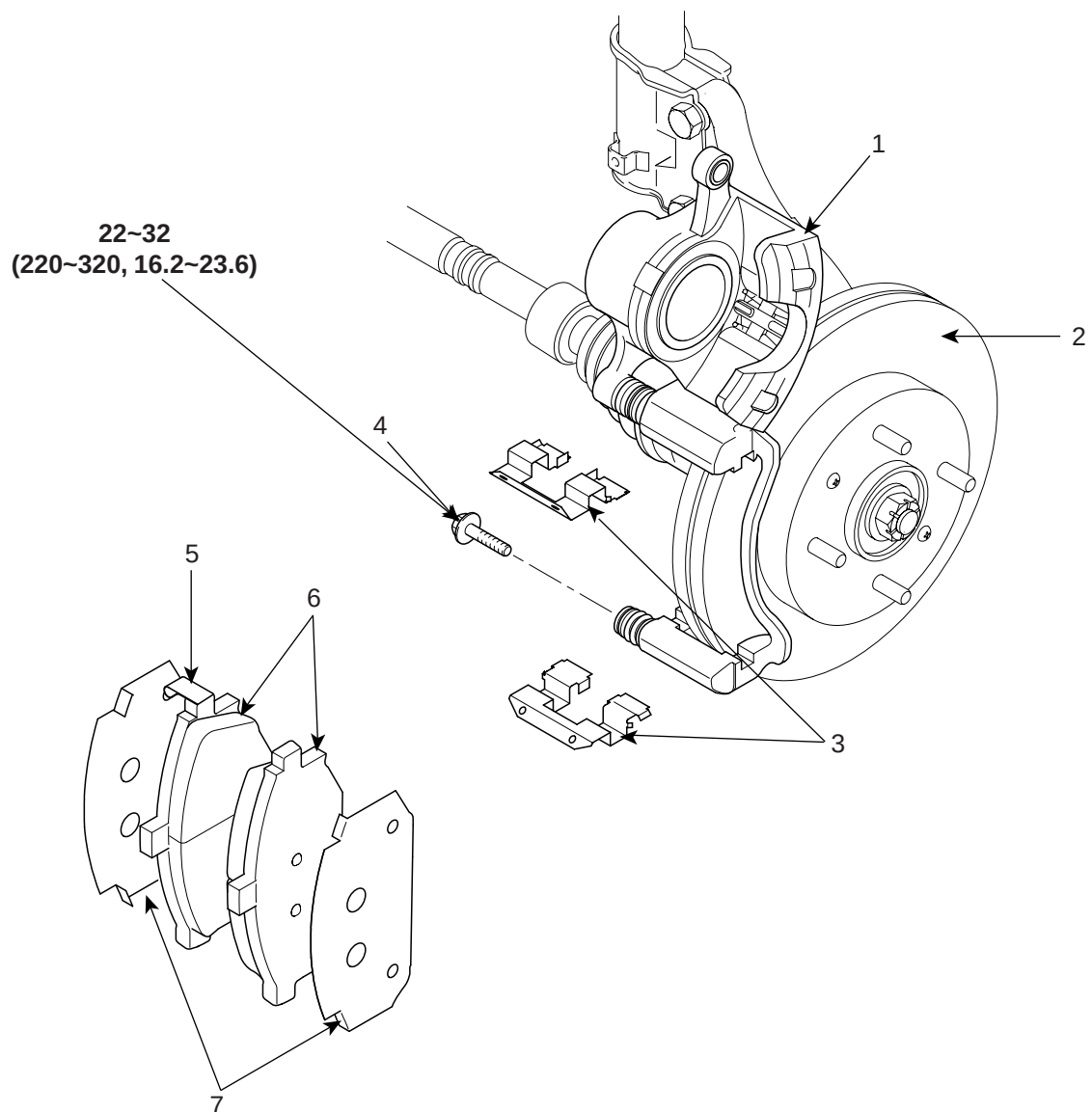
NOTE

This table shows characteristics of the proportioning valve as the pressure increases.

Front (Output of master cylinder)	Rear (Output of proportioning valve)
A : 26 kg/cm ² (2.55MPa, 370psi)	A' : 26 kg/cm ² (2.55MPa, 370psi)
B : 80 kg/cm ² (7.84MPa, 1137psi)	B' : 40.6 ± 3 kg/cm ² (3.98 ± 0.3MPa, 577 ± 42psi)

FRONT DISC BRAKE

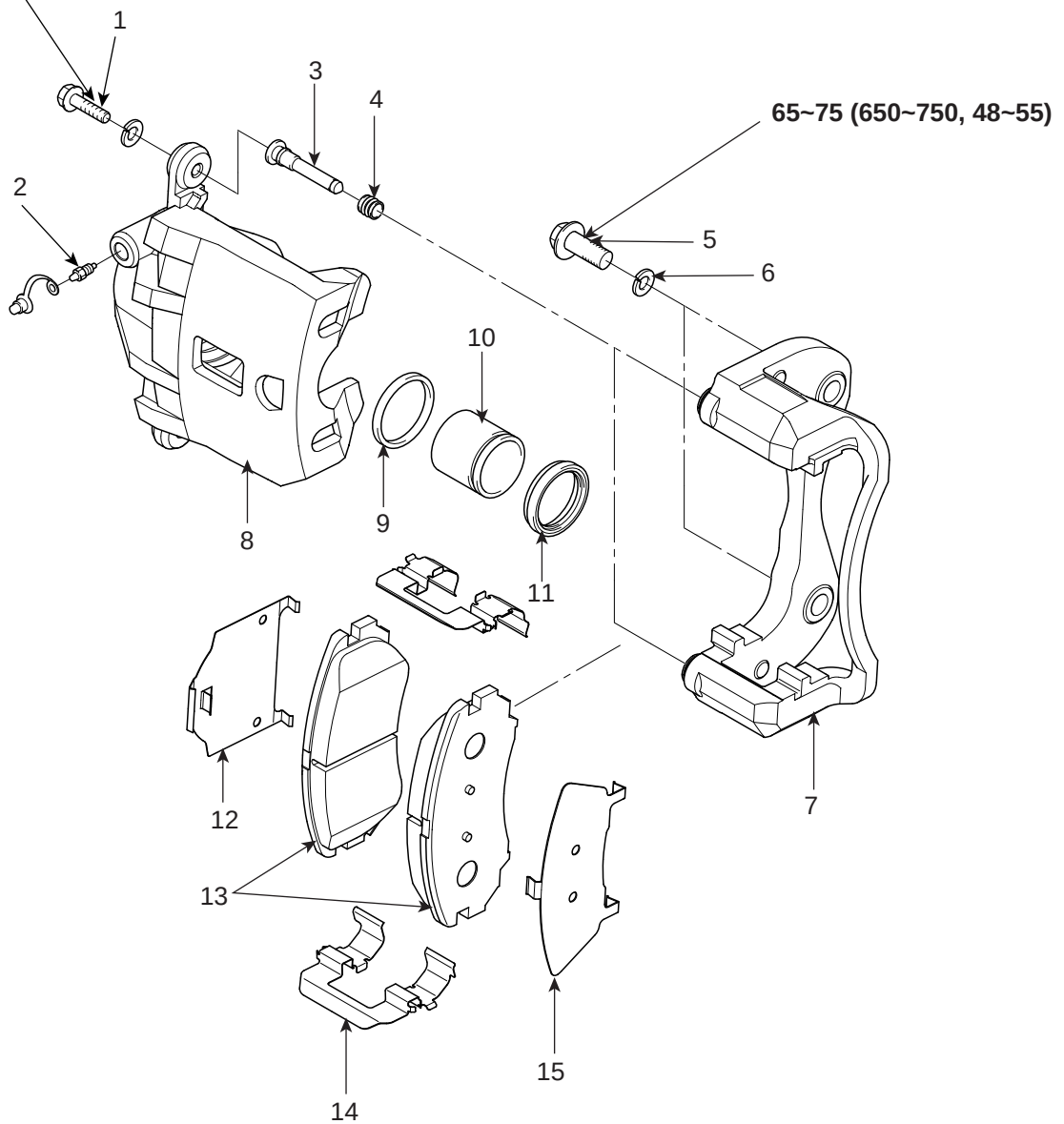
COMPONENTS EC472E7D



TORQUE: Nm (kgf-cm, lbf-ft)

- | | |
|-------------------|--------------------|
| 1. Brake caliper | 5. Indicator |
| 2. Brake disc | 6. Brake pads |
| 3. Pad retainers | 7. Brake pad shims |
| 4. Guide rod bolt | |

22~32 (220~320, 16.2~23.6)



TORQUE : Nm (kgf·cm, lbf·ft)

1. Guide rod bolt
2. Bleeder screw
3. Guide rod
4. Boot
5. Caliper mounting bolt

6. Washer
7. Caliper bracket
8. Caliper body
9. Piston seal
10. Piston

11. Piston boot
12. Inner shim
13. Brake pad
14. Pad retainer
15. Outer shim

LJIF500F

BRAKE SYSTEM

BR -33

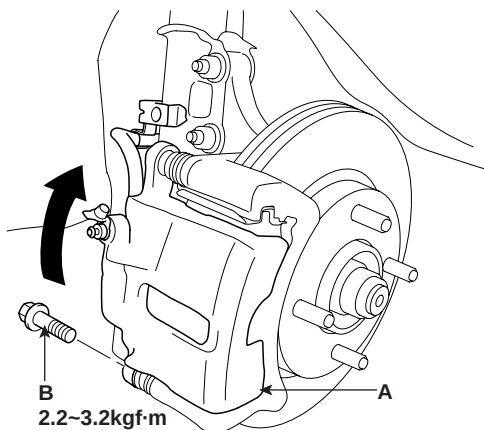
REMOVAL E54E735B

CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

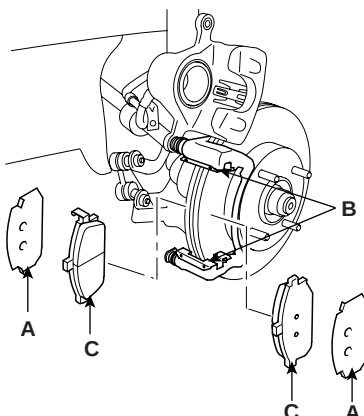
- **Avoid breathing dust particles.**
- **Never use on air hose or brush to clean brake assemblies.**

1. Loosen the front wheel nuts slightly. Raise the front of the vehicle, and make sure it is securely supported. Remove the front wheels.
2. Remove the guide rod bolt(B), After raise the caliper assembly(A), support it with a wire.



ARJE501K

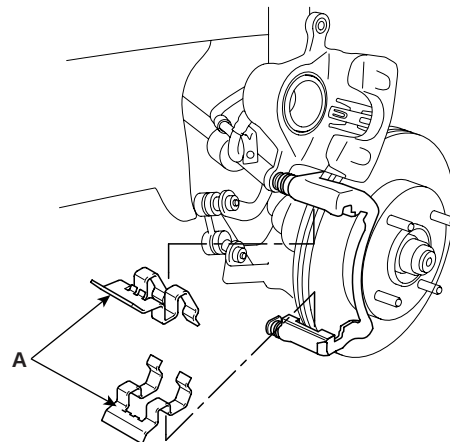
3. Remove pad shim(A), pad retainer(B) and pad assembly(C) in the caliper bracket.



ARJE501L

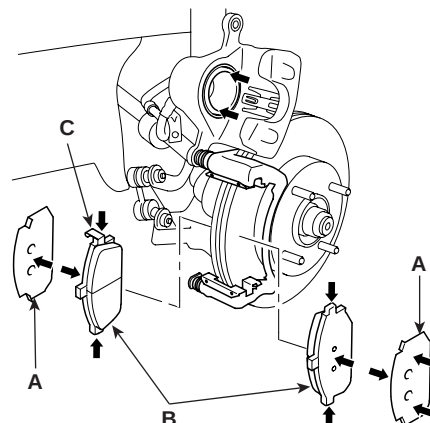
INSTALLATION EE57D064

1. Install the pad retainers (A) on the caliper bracket.



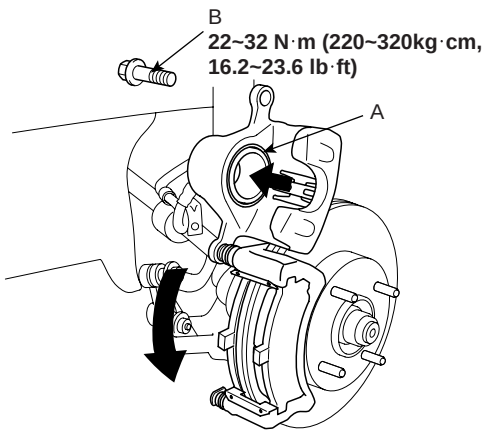
ARJE501M

2. Check the foreign material at the pad shims (A) and the back of the pads (B). Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.



ARJE501N

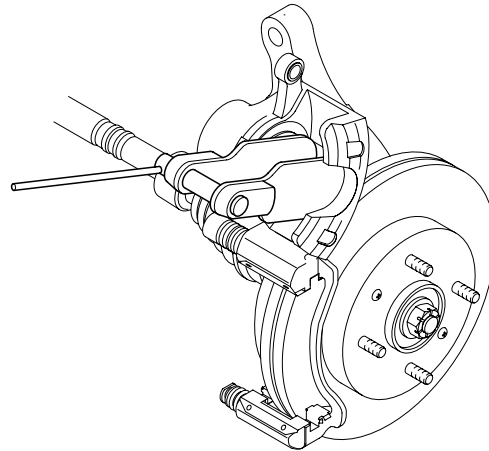
3. Install the brake pads (B) and pad shims (A) correctly. Install the pad with the wear indicator (C) on the inside.
If you are reusing the pads, always reinstall the brake pads in their original positions to prevent a momentary loss of braking efficiency.
4. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.
5. Pivot the caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification.



EGGE700K

NOTE

Insert the piston in the cylinder using the special tool (09581-11000).



EGGE700L

6. Depress the brake pedal several times to make sure the brakes work, then test-drive.

NOTE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.
Be sure to do this before driving the vehicle.

7. After installation, check for leaks at hose and line joints or connections, and retighten if necessary.

BRAKE SYSTEM

BR -35

INSPECTION ED9C981D

FRONT BRAKE DISC THICKNESS CHECK

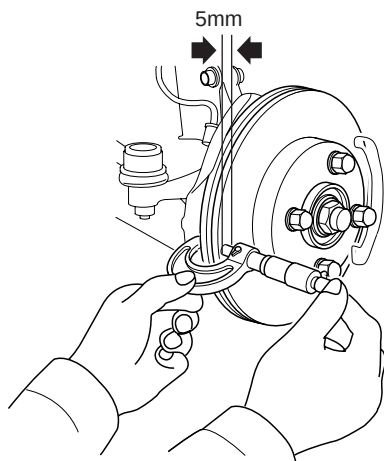
1. Remove all rust and contamination from the surface, and measure the disc thickness at 8 points, at least, of same distance (5mm) from the brake disc outer circle.

Front brake disc thickness

Standard value : 26.0mm(1.024 in.)

Limit : 24.4mm(0.961 in.)

2. Thickness variation should not exceed 0.005mm (0.0004 in.) (circumference) and 0.01mm (in.)(radius) at any directions.
3. If wear exceeds the limit, replace the discs and pad assembly left and right of the vehicle.



KJQE100D

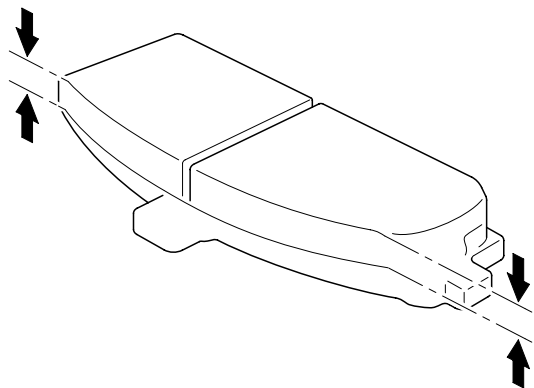
FRONT BRAKE PAD CHECK

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value : 11 mm (0.43 in.)

Service limit : 2.0 mm (0.0787 in.)



KJQE088A

2. Check that grease is applied to sliding contact points and the pad and backing metal for damage.

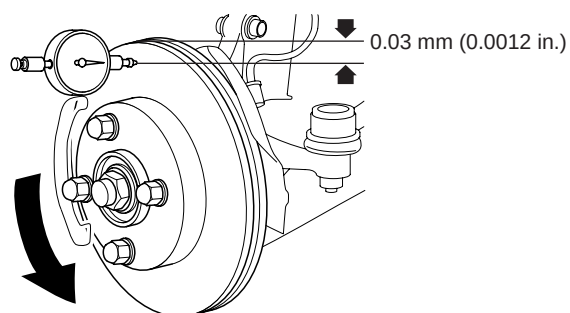
FRONT BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the run out of the disc.

Brake disc run out

Limit : 0.03 mm (0.0012 in.) or less

2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.



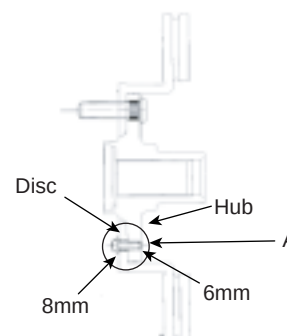
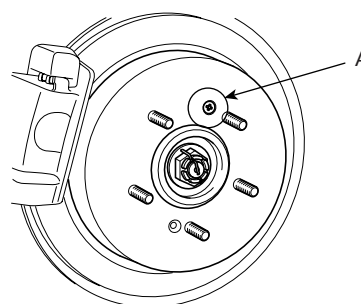
SEIZE OF FRONT BRAKE DISC

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.



NOTE

Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



LJIF500G

EJQE100C

BRAKE SYSTEM

BR -37

REAR DISC BRAKE

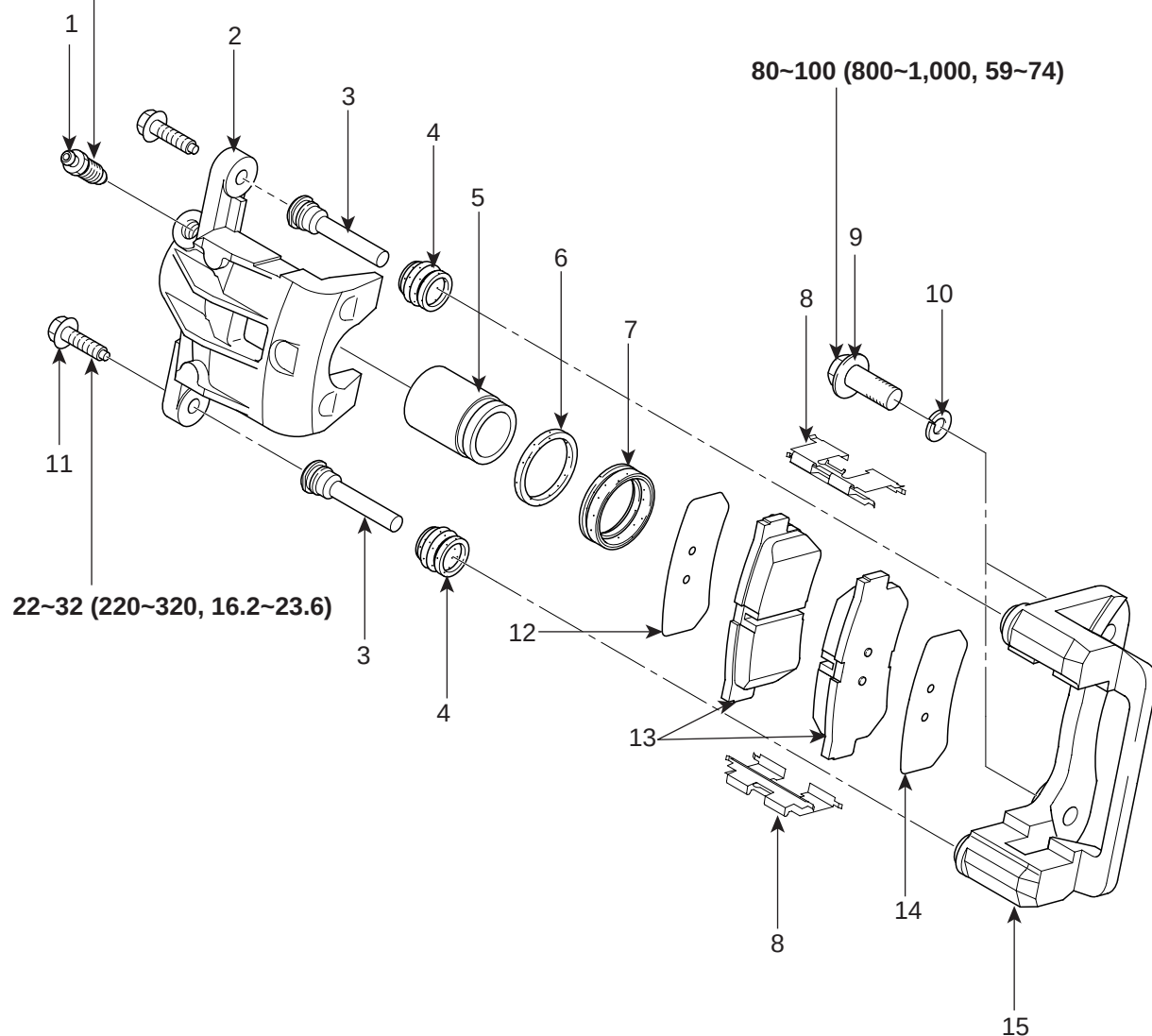
COMPONENTS

EAAC651A

7~13 (70~130, 5.2~9.6)

80~100 (800~1,000, 59~74)

22~32 (220~320, 16.2~23.6)



TORQUE : Nm (kgf·cm, lbt·ft)

1. Bleeder screw
2. Caliper body
3. Guide rod
4. Boot
5. Piston

6. Piston seal
7. Piston boot
8. Pad retainer
9. Caliper mounting bolt
10. Washer

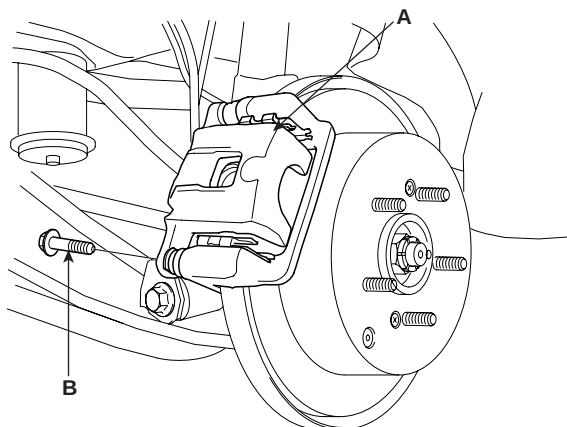
11. Guide rod bolt
12. Inner shim
13. Brake Pad
14. Outer shim
15. Caliper bracket

LJIF500H

REMOVAL

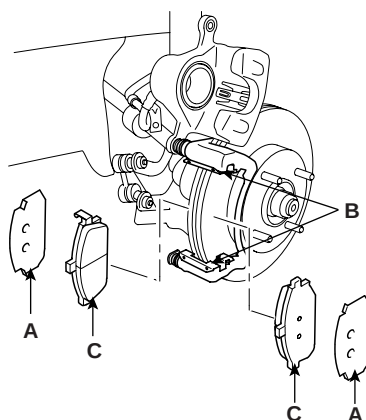
EBC2F57C

1. Raise the rear of the vehicle and make sure it is securely supported. Remove the rear wheel.
2. Remove the guide rod bolt(B), After raise the caliper assembly(A), support it with a wire.



ARJE501U

3. Remove pad shim(A), pad retainer(B) and pad assembly(C) in the caliper bracket.

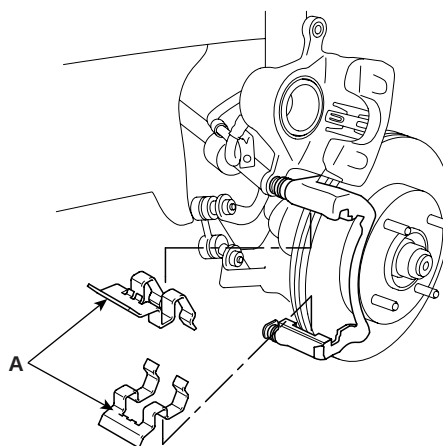


ARJE501V

INSTALLATION

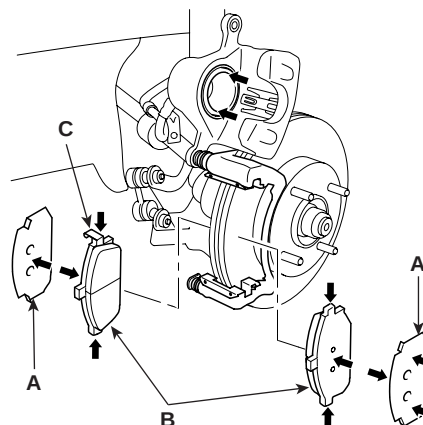
ED5BDB56

1. Install the pad retainers(A) on the caliper bracket.



ARJE501M

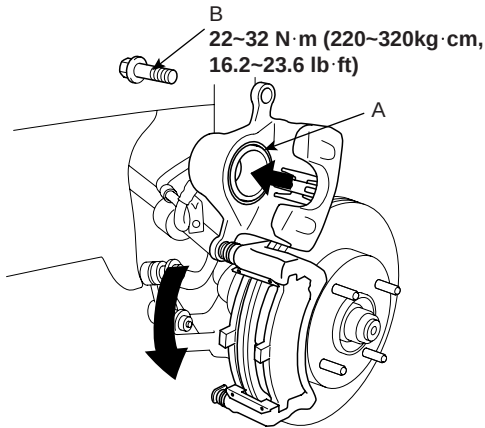
2. Check the foreign material at the pad shim (A) and the back of the pads (B).



ARJE501N

3. Contaminated brake discs or pads reduce stopping ability. Keep grease off the discs and pads.
4. Install the brake pads (B) and pad shims (A) correctly. Install the pad with the wear indicator (C) on the inside.
If you are reusing the pads, always reinstall the brake pads in their original position to prevent a momentary loss of braking efficiency.
5. Push in the piston (A) so that the caliper will fit over the pads. Make sure that the piston boot is in position to prevent damaging it when pivoting the caliper down.

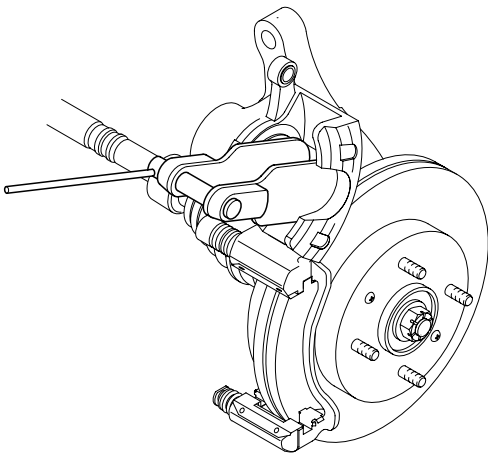
- Pivot caliper down into position. Being careful not to damage the pin boot, install the guide rod bolt (B) and torque it to proper specification



EGGE700K

NOTE

Insert the piston in the cylinder using the special tool(09581-11000).



EGGE700L

- Depress the brake pedal several time to make sure the brakes work, then test-drive.

NOTE

Engagement of the brake may require a greater pedal stroke immediately after the brake pads have been replaced as a set. Several applications of the brake will restore the normal pedal stroke.

- After installaion, check for leaks at hose and line joints or connections, and retighten if necessary.

INSPECTION

E8FBBA79

REAR BRAKE DISC THICKNESS CHECK

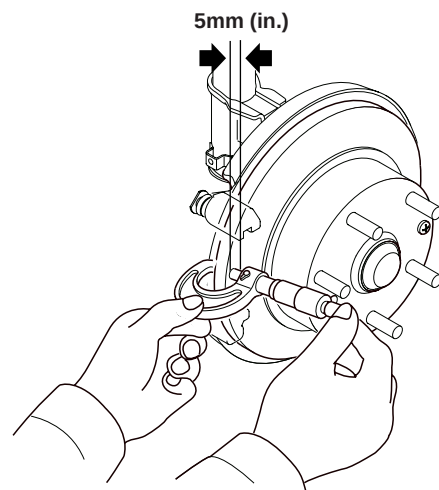
- Remove all rust and contamination from the disc surface, and then measure the disc thickness at 8 points, al least, of the same distance (5mm) from the brake disk outer circle.

Rear brake disc thickness

Standard value : 10.0mm (0.39 in.)

Limit : 8.0mm (0.315 in.)

- Thickness variation should not exceed 0.005mm (0.0002 in.) (circumference) and 0.01mm(0.0020 in.) (radius) at any directions.
- If wear exceeds the limit, replace the discs and pad assembly for left and right of the vehicle.



LJIF501R

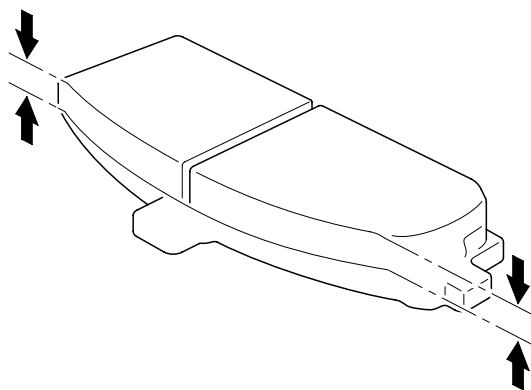
REAR BRAKE PAD CHECK

1. Check the pad wear. Measure the pad thickness and replace it, if it is less than the specified value.

Pad thickness

Standard value : 10.0 mm (0.39in.)

Service limit : 2.0 mm (0.0787 in.)



KJQE088A

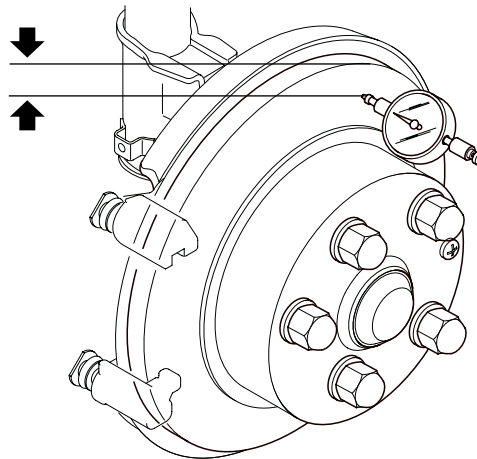
2. Check that grease is applied, and the pad and backing metal for damage.

REAR BRAKE DISC RUN OUT CHECK

1. Place a dial gauge about 5mm (0.2 in.) from the outer circumference of the brake disc, and measure the run out of the disc.

Brake disc run out

Limit : 0.03 mm (0.0012 in.) or less



KJQE100E

2. If the run out of the brake disc exceeds the limit specification, replace the disc, and then measure the run out again.
3. If the run out does not exceed the limit specification, install the brake disc after turning it 180° and then check the run out of the brake disc again.
4. If the run out cannot be corrected by changing the position of the brake disc, replace the brake disc.

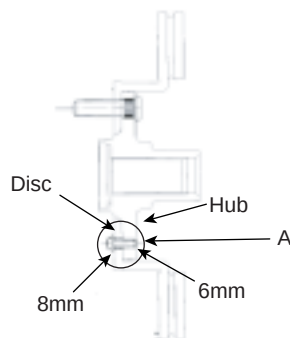
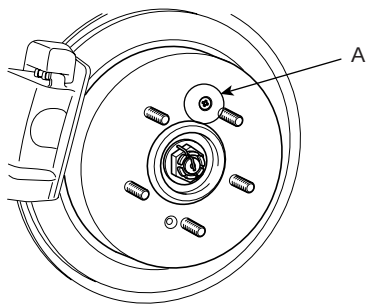
SEIZE OF REAR BRAKE DISC

1. Remove the brake disc from hub using M8 screw(A) if the brake disc has been seized with the hub due to corrosion or overheat.



NOTE

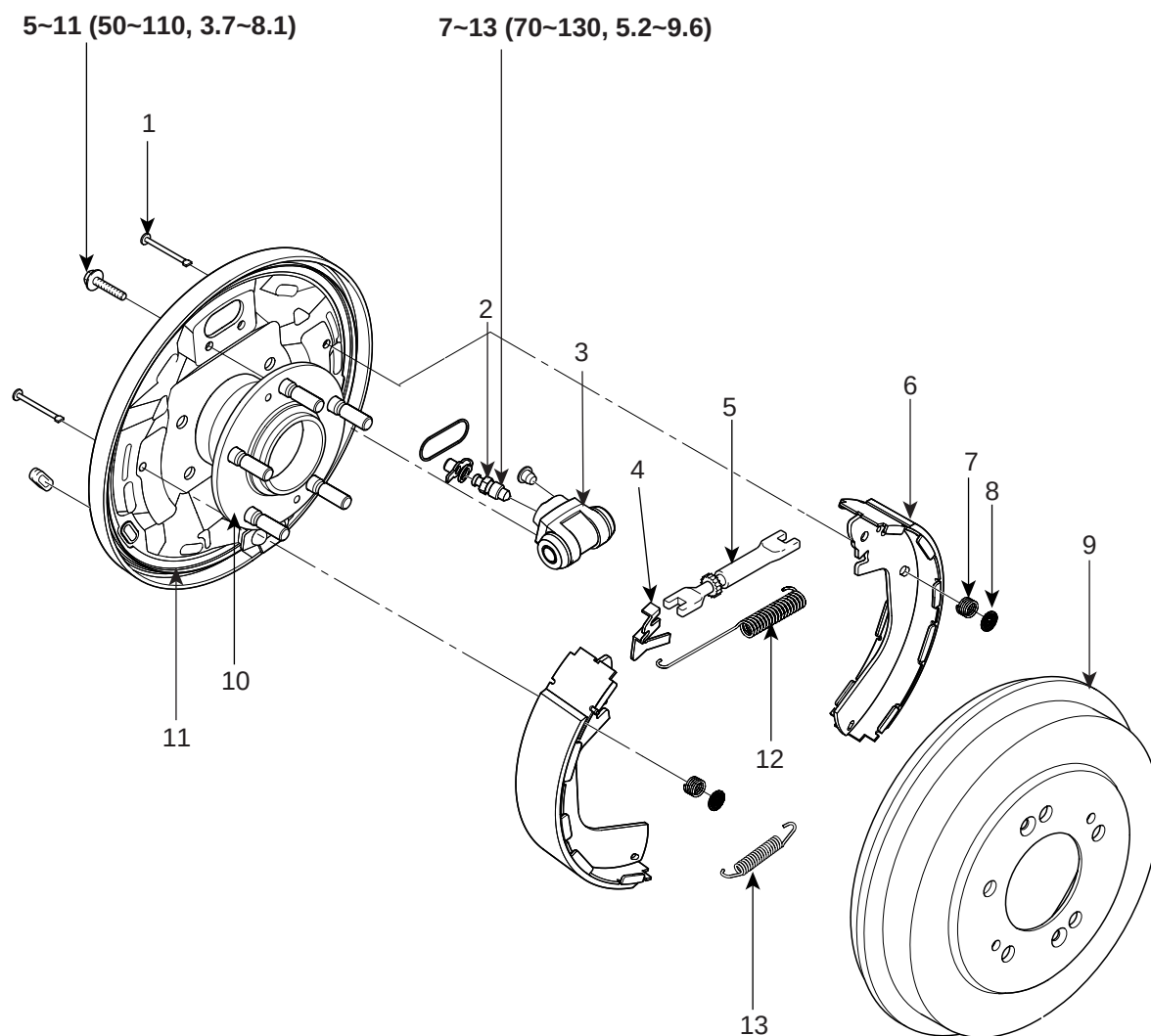
Be careful not to use the hammer. The disc can be damaged if you remove the disc from the hub by hammer.



LJIF5001

REAR DRUM BRAKE

COMPONENTS E0E42A59



TORQUE : Nm (Kgf·cm, lbf·ft)

- | | |
|---------------------------|------------------------------|
| 1. Shoe hold down pin | 8. Cup washer |
| 2. Bleeder screw | 9. Brake drum |
| 3. Wheel cylinder | 10. Rear hub |
| 4. Shoe adjuster lever | 11. Rear brake backing plate |
| 5. Shoe adjuster | 12. Upper shoe return spring |
| 6. Shoe & lining assembly | 13. Lower shoe return spring |
| 7. Shoe hold down spring | |

LJIF500K

BRAKE SYSTEM

BR -43

REMOVAL EBB4A8B5

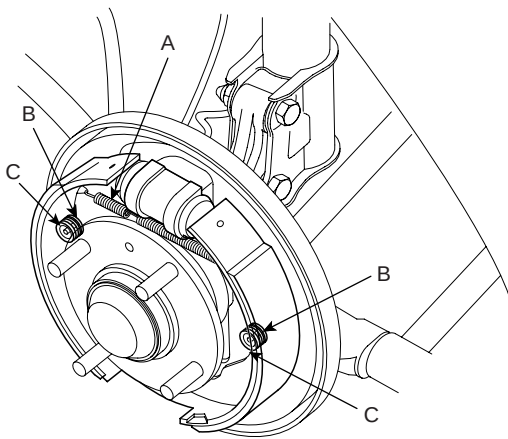


CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- **Avoid breathing dust particles.**
- **Never use an air hose or brush to clean brake assemblies.**

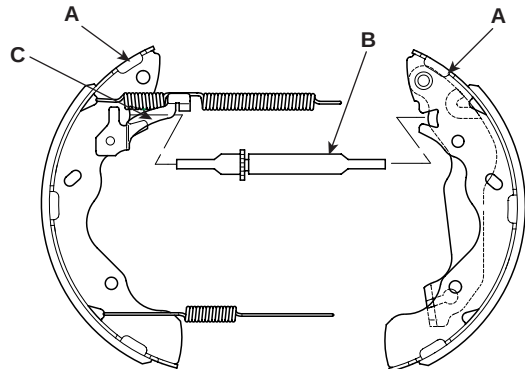
1. Remove the shoe hold down pins (B) by pushing the shoe hold cup washer (C) and turning them.
2. Disengage the upper return spring (A).



EGGE700T

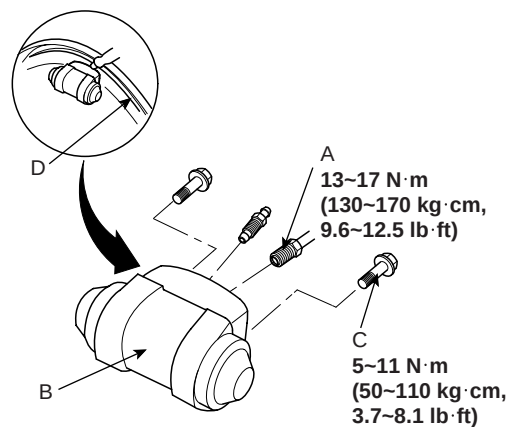
3. Remove the lower shoe return spring (B) as removing the brake shoe assembly (A). Make sure not to damage the dust cover on the wheel cylinder.
4. Disconnect the parking brake cable from the parking brake lever.
5. Remove the brake shoe assembly.

6. Remove shoe adjuster (B) and lever (C) from the brake shoes.



ARJE502H

7. Disconnect the brake tube (A) from the wheel cylinder.
8. Remove the bolt (C) and the wheel cylinder from the backing plate (D).



LJIF501W

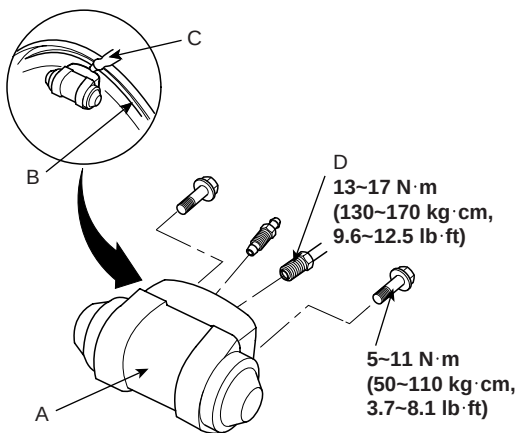
INSTALLATION

E12B9A3E

NOTE

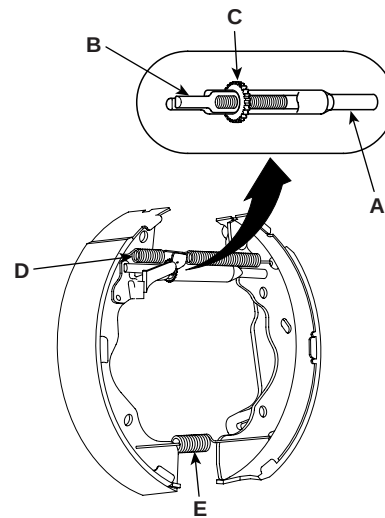
- Do not spill brake fluid on the vehicle: it may damage the paint; if brake fluid does contact the paint. Wash it off immediately with water.
- To prevent spills, cover the hose joints with rags or shop towels.
- Use only a genuine wheel cylinder special bolt.

1. Apply sealant (C) between the wheel cylinder (A) and backing plate (B), and install the wheel cylinder.



LJIF501X

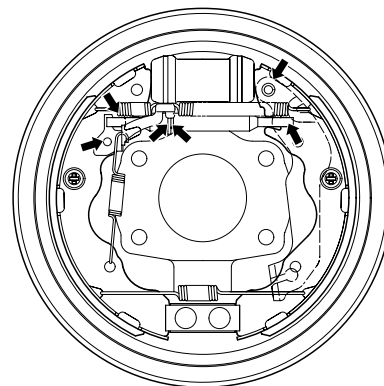
2. Connect the brake tubes (D) to the wheel cylinder.
3. Connect the parking brake cable to the parking brake lever.
4. Clean the threaded portions of adjuster sleeve (A) and push rod female (B). Grease the threads of the adjuster assembly, turn the adjuster bolt (C), adjusting the length of the shoe adjuster assembly.



LJIF501Y

5. Hook the shoe adjuster then install to the brake shoe.
6. Install the shoe adjuster assembly and upper return spring (D), noting the installation direction. Be careful not to damage the wheel cylinder dust covers.
7. Install the lower return spring (E).
8. Grease brake cylinder to the sliding surfaces as shown below. Wipe off any excess. Don't get grease on the brake linings.

➡ Sliding surface



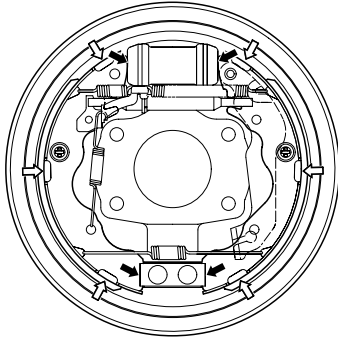
EGGE700V

9. Grease brake cylinder to the brake shoe ends and opposite edges of the shoes as shown below. Wipe off any excess. Don't get grease on the brake linings.

INSPECTION

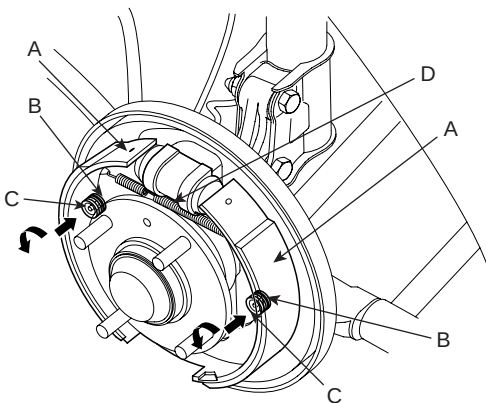
EEE29039

- ➡ Opposite edge of the shoe
⇨ Brake shoe ends
(shoe side ends and backing
plate contact surface)



EGGE700W

10. Grease brake shoes (A) onto the backing plate. Be careful not to damage the wheel cylinder dust covers.
11. Install the shoe hold down pins (B), shoe hold down spring and the shoe hold down cup (C).



EJKE803F

12. Install the brake drum.
13. Bleed the brake system, after refilling the brake fluid.
14. Depress the brake pedal several times to set the self-adjusting brake.
15. Adjust the parking brake.



CAUTION

Frequent inhalation of brake pad dust, regardless of material composition, could be hazardous to your health.

- Avoid breathing dust particles.
- Never use an air hose or brush to clean brake assemblies.



NOTE

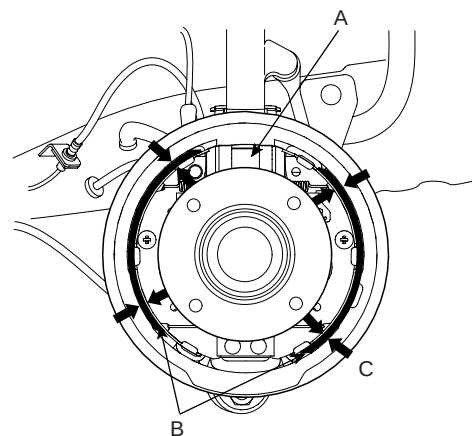
- Contaminated brake linings or drums reduce stopping ability.
- Block the front wheels before jacking up the rear of the vehicle.

1. Raise the rear of the vehicle, and make sure it is securely supported.
2. Release the parking brake, and remove the rear brake drum.
3. Check the wheel cylinder (A) for leakage.
4. Check the brake linings (B) for cracking, glazing, wear, and contamination.
5. Measure the brake lining thickness (C).
Measurement does not include brake shoe thickness.

Brake lining thickness

Standard : 4.5 mm (0.177 in.)

Service limit : 1.0 mm (0.039 in.)



EGGE700R

6. If the brake lining thickness is less than the service limit, replace the brake shoes as a set.
7. Check the bearings in the hub unit for smooth operation. If it requires servicing, replace it.
8. Measure the inside diameter of the brake drum with inside vernier calipers.

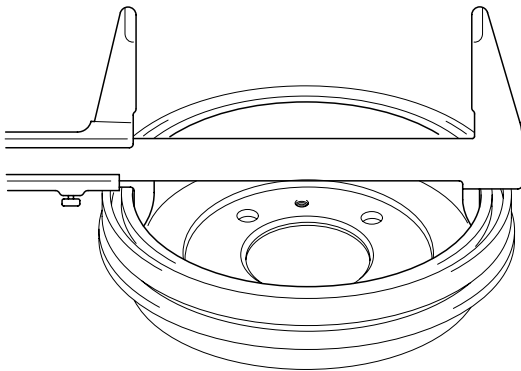
Drum inside diameter:

Standard : 228.6 mm (9 in.)

Service limit : 230.6 mm (9.079in.)

Drum roundness

Service limit : 0.06mm (0.00236in.)

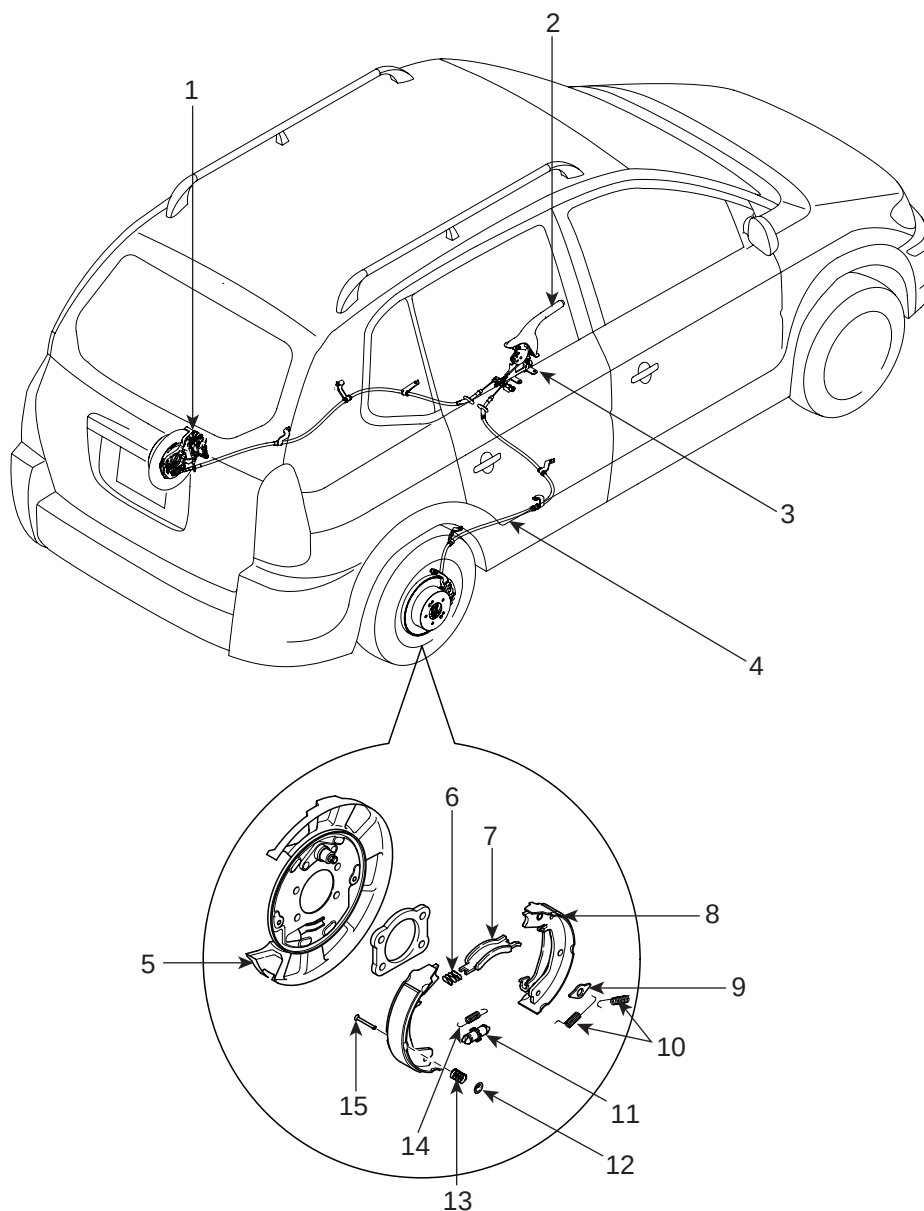


EGGE700S

9. If the inside diameter of the brake drum is more than the service limit, replace the brake drum.
10. Check the brake drum for scoring, grooves, and cracks.

PARKING BRAKE SYSTEM

COMPONENTS E07C3441



1. Rear brake caliper
2. Parking brake lever
3. Parking brake switch
4. Parking brake cable
5. Backing plate

6. Thrust spring
7. Thrust
8. Shoes & linings
9. Shoe guide
10. Return spring

11. Adjuster
12. Cup washer
13. Shoe hold down spring
14. Return spring
15. Shoe hold down pin

LJIF500L

PARKING BRAKE CHECK AND ADJUSTMENT

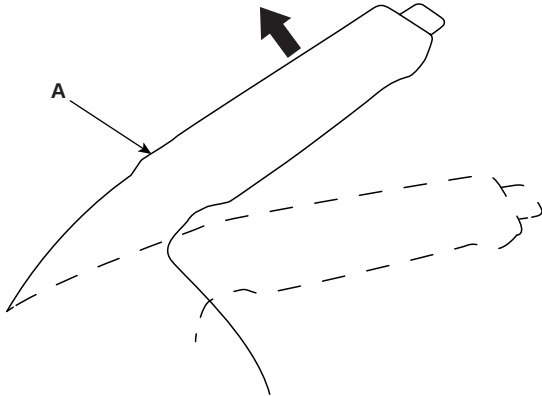
E49CA0E5

INSPECTION

1. Pull the parking brake lever (A) with 196 N (20 kg, 44lbf) force to fully apply the parking brake. The parking brake lever should be locked within the specified number of clicks.

Lever locked clicks: 7~8

Pulled up with 196 N (20 kg, 44 lb)



LJIF500M

2. Adjust the parking brake if the lever clicks are out of specification.

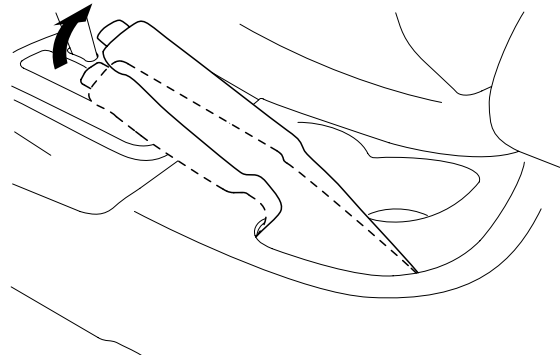
ADJUSTMENT



NOTE

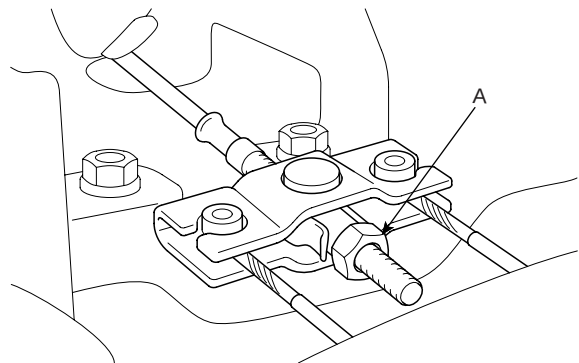
After rear brake caliper servicing, loosen the parking brake adjusting nut, start the engine and depress the brake pedal several times to set the self-adjusting brake before adjusting the parking brake.

1. Block the front wheels, then raise the rear of the vehicle and make sure it is securely supported.
2. Pull the parking brake lever up one click.



EJKE002C

3. Remove the floor console.
4. Tighten the adjusting nut (A) until the parking brakes are dragged slightly when the rear wheels are turned.



EJKE002D

5. Release the parking brake lever completely, and check if parking brakes are not dragged when the rear wheels are turned. Readjust if necessary.
6. Make sure that the parking brakes are fully applied when the parking brake lever is pulled up completely.
7. Reinstall the floor console.

PARKING BRAKE SYSTEM

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PARKING BRAKE

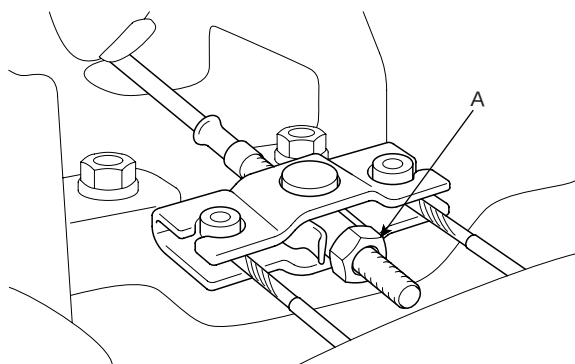
REMOVAL E320D460

NOTE

The parking brake cables must not be bent or distorted.

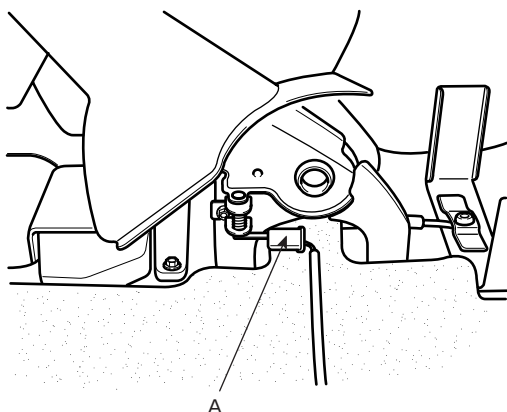
This will lead to stiff operation and premature failure.

1. Remove the floor console.
2. Loosen the adjusting nut (A) and remove the parking brake cables.



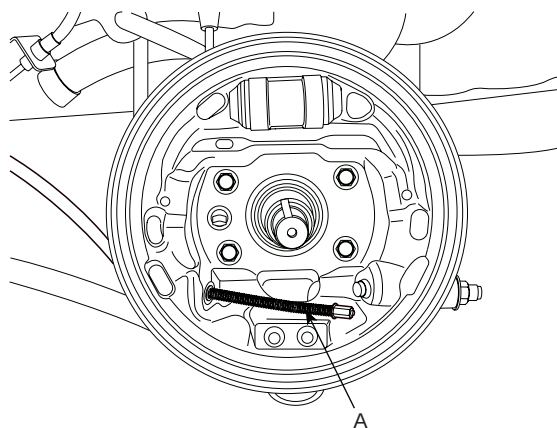
EJKE002D

3. Disconnect the connector(A) of the parking brake switch connector.



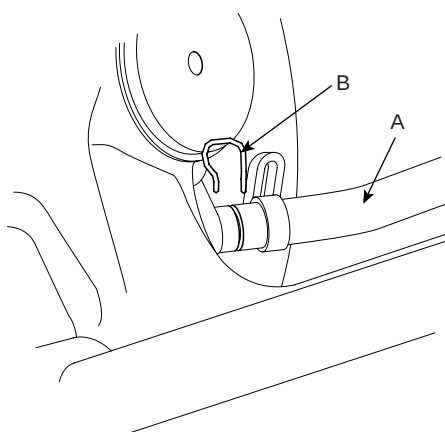
EGGE700X

4. Remove the bolts and parking brake lever assembly(A).
5. Remove the wheel and tire.
6. Remove the brake drum and the brake shoe (Refer to the rear drum brake).
7. Remove the parking brake cable(A) from the brake shoe.



KJQE040K

8. Remove the parking brake cable retaining ring (B), from the parking brake cable (A).



EJKE900B

9. Remove the parking brake cable assembly.

INSTALLATION EC334BED

1. Install the removed parts in the reverse order of removal.
2. Apply the specified grease to each sliding parts of the ratchet plate or the ratchet pawl.

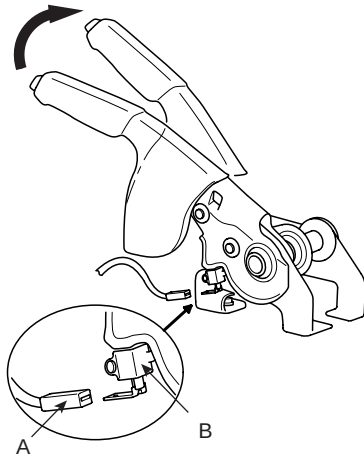
Specified grease :
Multi purpose grease SAE J310, NLGI No.2

3. After installing the parking brake cable adjuster, adjust the parking brake lever stroke (Refer to the parking brake check and adjustment).

PARKING BRAKE SWITCH

INSPECTION E37132FC

1. Remove the floor console and the switch (B) from the connector (A).

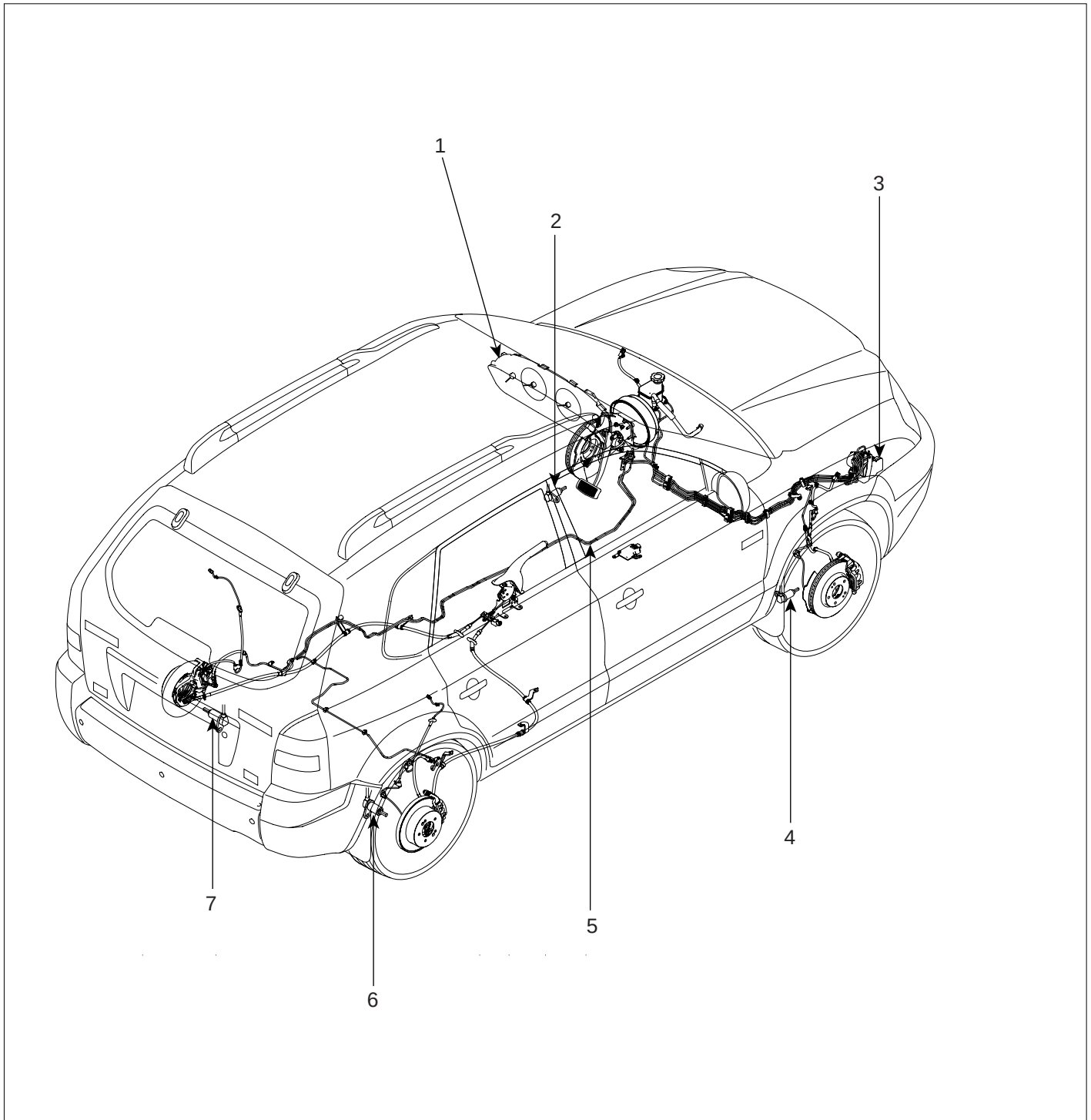


EJQE004R

2. Inspect the continuity between (-) terminal and the ground.
 - When the brake lever is pulled, there should be the continuity between them.
 - When the brake lever is released, there should be no continuity between them.

ABS (ANTI-LOCK BRAKE SYSTEM)

COMPONENTS EFD2D5DE



1. Cluster
 - ABS Warning lamp
 - EBD/Parking brake warning lamp
2. Front left wheel speed sensor
3. ABS control module (HECU)

4. Front right wheel speed sensor
5. Hydraulic line
6. Rear right wheel speed sensor
7. Rear left wheel speed sensor

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -53

DESCRIPTION E454EC39

This specification applies to HCU(Hydraulic Control Unit) and ECU(Electronic Control Unit) of the HECU.(Hydraulic and Electronic Control Unit)

This specification is for the wiring design and installation of ABS/TCS/ESP ECU.

This unit has the functions as follows.

- Input of signal from Pressure sensor, Steering angle sensor, Yaw & Lateral G sensor, the wheel speed sensors attached to each wheel.
- Control of braking force / traction force/ yaw moment.
- Failsafe function.
- Self diagnosis function.
- Interface with the external diagnosis tester.

Installation position : engine compartment

- Brake tube length from Master cylinder port to HECU inlet port should be max. 1m
- The position should not be close to the engine block and not lower than the wheel.

OPERATION

The ECU shall be put into operation by switching on the operating voltage (IGN).

On completion of the initialization phase, the ECU shall be ready for operation.

In the operating condition, the ECU shall be ready, within the specified limits (voltage and temperature), to process the signals offered by the various sensors and switches in accordance with the control algorithm defined by the software and to control the hydraulic and electrical actuators.

WHEEL SENSOR SIGNAL PROCESSING

The ECU shall receive wheel speed signal from the four active wheel sensors.

The wheel signals are converted to voltage signal by the signal conditioning circuit after receiving current signal from active wheel sensors and given as input to the MCU.

SOLENOID VALVE CONTROL

When one side of the valve coil is connected to the positive voltage that is provided through the valve relay and the other side is connected to the ground by the semiconductor circuit, the solenoid valve goes into operation.

The electrical function of the coils are always monitored by the valve test pulse under normal operation conditions.

VOLTAGE LIMITS

- Overvoltage
When overvoltage is detected(above 16V), the ECU switches off the valve relay and shuts down the system.
When voltage is returned to operating range, the system goes back to the normal condition after the initialization phase.
- Undervoltage
In the event of undervoltage(below 10V), ABS control shall be inhibited and the warning lamp shall be turned on.
When voltage is returned to operating range, the warning lamp is switched off and ECU returns to normal operating mode.

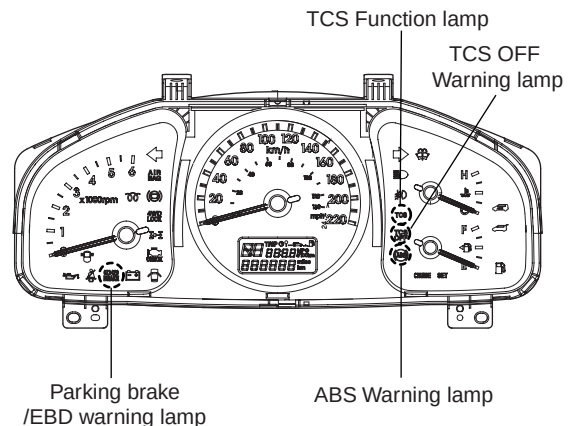
PUMP MOTOR CHECKING

The ECU performs a pump motor test at a speed of 12km/h once after IGN is switched on.

DIAGNOSTIC INTERFACE

Failures detected by the ECU are encoded on the ECU, stored in a EEPROM and read out by diagnostic equipment when the ignition switch is turned on.

The diagnosis interface can also be used for testing the ECU during production of the ECU and for actuating the HCU in the test line of manufactories (Air-bleeding line or Roll and Brake Test line).



LJIF5000

ABS WARNING LAMP MODULE

The active ABS warning lamp module indicates the self-test and failure status of the ABS.

The ABS warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

EBD WARNING LAMP MODULE

The active EBD warning lamp module indicates the self-test and failure status of the EBD.

However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions.

The EBD warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

TCS WARNING LAMP (TCS SYSTEM)

The TCS warning lamp indicates the self-test and failure status of the TCS.

The TCS warning lamp is turned on under the following conditions.

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of TCS functions by failure.
- When driver turn off the TCS function by on/off switch.
- During diagnostic mode.

TCS FUNCTION LAMP (TCS SYSTEM)

The TCS function lamp indicates the self-test and operating status of the TCS.

The TCS Function lamp operates under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the TCS control is operating. (Blinking - 2Hz)

TCS ON/OFF SWITCH (TCS SYSTEM)

The TCS On/Off Switch shall be used to toggle the TCS function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch.

Closed contacts switch the circuit to ignition.

Initial status of the TCS function is on and switch toggle the state.

ABS (ANTI-LOCK BRAKE SYSTEM)

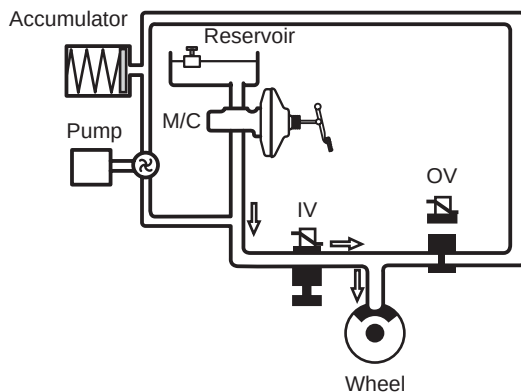
BR -55

ABS CONTROL EFC9BCEA

1. NORMAL BRAKING without ABS

Solenoid valve	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	OPEN	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder ⇔ Reservoir	

When braking, the hydraulic pressure in the TMC is increased. The pressure reaches the wheel brake via the current less open inlet valve IV. The current less closed outlet valve OV is closed. For the sake of simplicity the diagram is limited to only the solenoid valve pair of one brake circuit. The wheel speed is reduced as the brake pressure increases, in the extreme case until the wheel locks.



EJQE015A

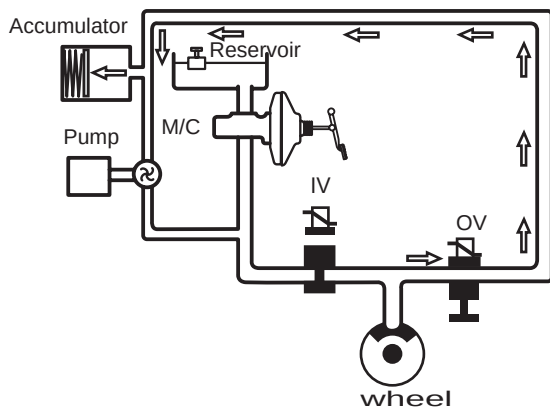
2. With ABS

1) DUMP MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	CLOSE	Master cylinder $\leftrightarrow$ Wheel cylinder	ON
Outlet valve (NC)	ON	OPEN	Wheel cylinder $\leftrightarrow$ Reservoir	

If the wheel speed decreases, there is still a tendency to lock; the brake pressure on the corresponding wheel must be reduced accordingly. For this, the outlet valve OV is opened, the inlet valve IV remains closed.

The brake pressure to the low-pressure accumulator is reduced. The wheel in danger of locking gains speed again.

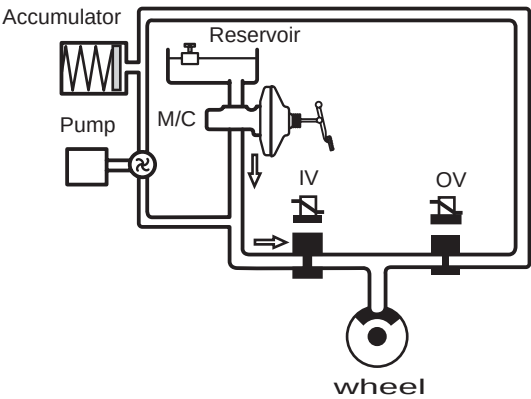


EJQE016A

2) HOLD MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	ON	CLOSE	Master cylinder ⇔ Wheel cylinder	OFF
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder ⇔ Reservoir	

When a wheel (or several) tends to lock the inlet valve IV is first closed to avoid a further increase in brake pressure. The outlet valve OV remains closed: the brake pressure is kept constant.



EJQE017A

3) INCREASE MODE

Solenoid	State	Valve	Passage	Pump motor
Inlet valve (NO)	OFF	OPEN	Master cylinder $\leftrightarrow$ Wheel cylinder	ON
Outlet valve (NC)	OFF	CLOSE	Wheel cylinder $\leftrightarrow$ Reservoir	

For optimum brake from the certain wheel acceleration a brake pressure increase is necessary. For this, the inlet valve IV is opened and the outlet valve OV is closed. The pump of the unit starts to run and aspirates the necessary quantity of fluid from the Low-pressure accumulator, in order to produce the necessary brake pressure for the pressure increase phase in seconds.

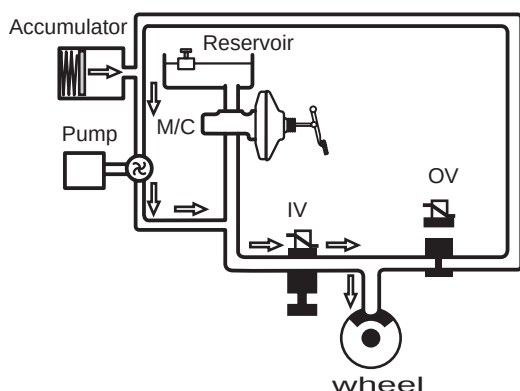
With an increase in the brake pressure the wheel speed is reduced. These control phases are repeated until the ABS control unit no longer detects any tendency of the wheels to lock.

Conventional brake system operates under the circumstance.



NOTE

During ABS control function, the brake pedal only moves in accordance with the volume requirement of the wheels. Because of a sudden change in friction coefficient this pedal movement may increase slightly.



EJQE018A

3. Fail Safe Function

If there is a problem with the ABS system, the Failsafe function operates, turning off the relay which supplies the power to the solenoid valve, stopping the output of the control signal, and turning on the ABS warning lamp in order to warn the user of malfunction of the ABS system.

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -59

TRACTION CONTROL SYSTEM (TCS)

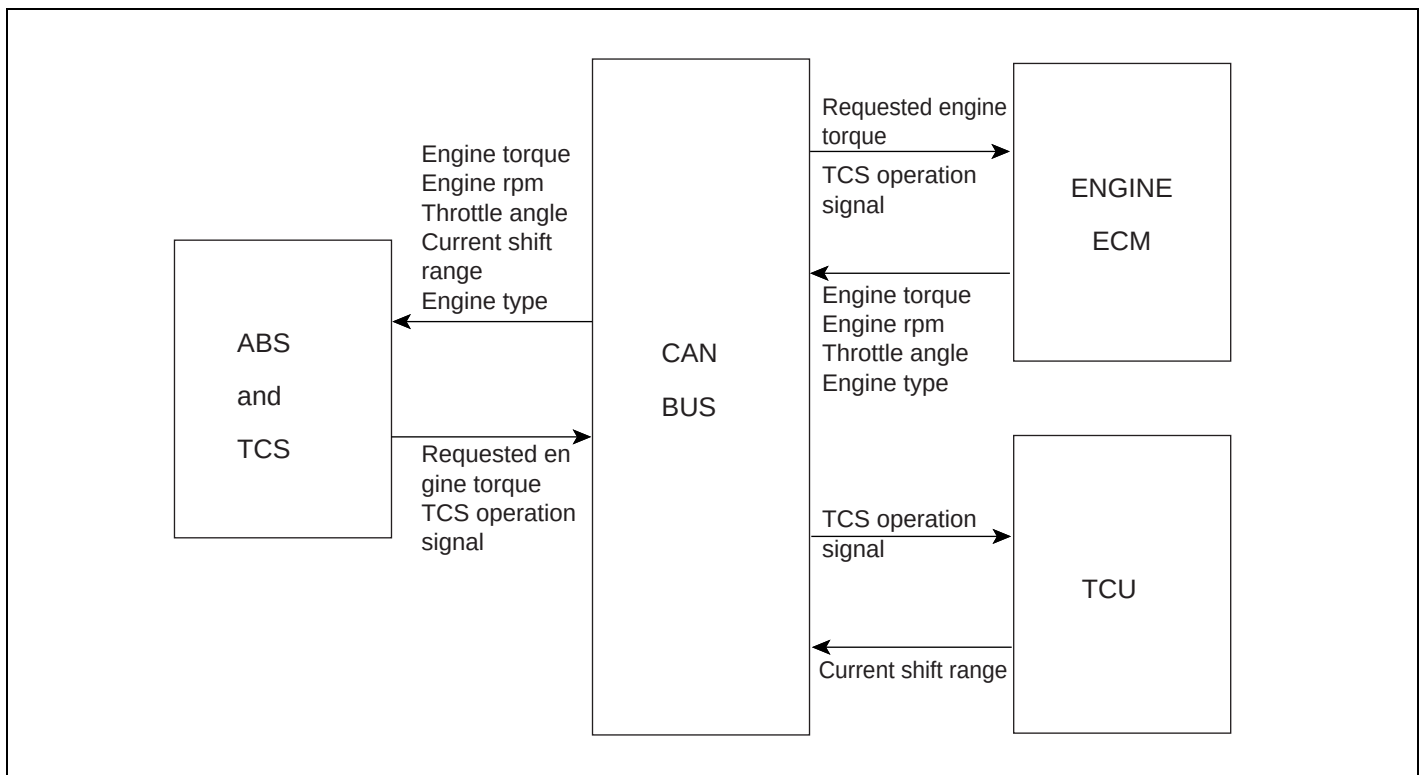
FUNCTION

1. Main performance
 - Traction: Lower vibration and higher launchability, acceleration and climbability by slip control.
 - Cornering and passing: Stable cornering and passing.
 - Steering stability: Control traction force traverse vector prior to provide easy turning when turning the steering wheel.
2. General TCS features
 - Improved drivability. Minor operation of acceleration is not necessary in launching and acceleration on slippery road.
 - More stable cornering by stable acceleration on normal road condition.
 - TCS system will compare vehicle speed received from rear wheel speed sensor and driving wheel speed from front wheel speed sensor on slippery road condition, and provide optimum slipping rate of driving wheels.

TYPE

FULL TRACTION CONTROL SYSTEM (FTCS)

1. The TCS control module (HECU) controls TCS control. It includes ABS control module.
2. HECU will compare signals from front (driving) and rear wheel speed sensors to detect driving wheels slip.
3. Upon detecting driving wheels slip, HECU will perform TCS control. The TCS control will include brake TCS (BTCS) control.
4. HECU will transmit engine torque reduction request, fuel cut cylinder number, and TCS control request signals in accordance with slip level to engine ECM and TCM through BUS line which will provide CAN communication for TCS control.
5. Engine ECM will perform fuel cut as requested by HECU and retard ignition timing as per engine torque reduction request signal.
6. TCM will hold shift position by TCS control time according to TCS operation signal. Then enhanced acceleration by kick-down will not occur.



EJQE027A

BRAKE TRACTION CONTROL SYSTEM (BTCS)

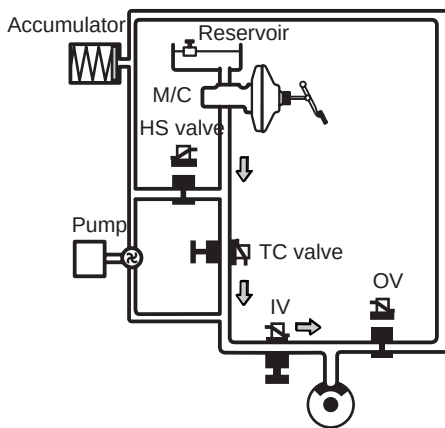
1. On TCS control, only brake control will be performed. (engine and TCM control will not happen)
2. Controlled by motor pump output pressure.

TRACTION CONTROL SYSTEM (TCS)

1. NORMAL MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	OFF	OPEN	OFF	OFF
Outlet (NC)	OFF	CLOSE		

- In the normal driving condition, TC valve (normally open) is the passage between the master cylinder and the each wheel cylinder.
- When brake pedal is applied, brake pressure is delivered to the wheel cylinders via NO-TC valve and all solenoid valves inside the hydraulic unit are deactivated.
- In case of TCS malfunction, it does not affect brake operation.



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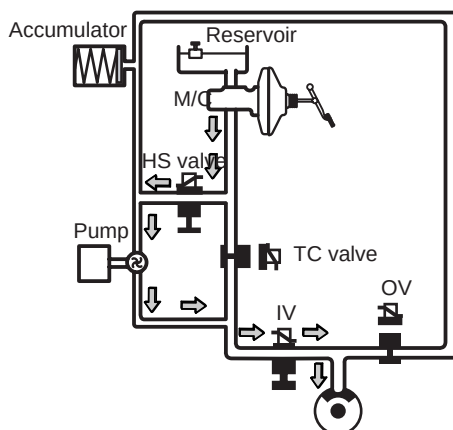
ABS (ANTI-LOCK BRAKE SYSTEM)

BR -61

2. PRESSURE INCREASE MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	FRONT: OFF REAR: ON	FRONT: OPEN REAR: CLOSE	ON	ON
Outlet (NC)	OFF	CLOSE		

- If a front wheel spin is detected, TCS begins a brake control to decrease a wheel spin.
- Hydraulic shuttle valve (HSV) is opened. Brake fluid is supplied from the master cylinder by motor operation to the spin wheel via HSV.
- TC valve is closed (ON).
Brake pressure generated from motor pump is delivered only to the front wheel.
- Inlet valve remains open to deliver the brake pressure generated from motor pump to the spinning wheels.

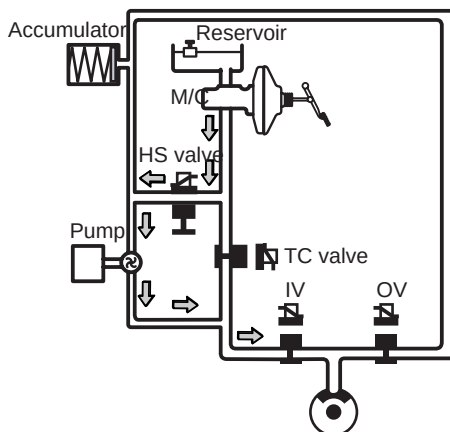


LJCD020A

3. PRESSURE DUMP MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	ON	CLOSE	ON	ON
Outlet (NC)	FRONT : ON REAR : OFF	FRONT : OPEN REAR : CLOSE		

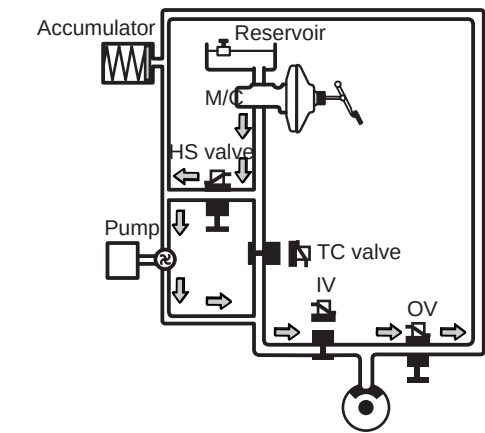
- When the wheel deceleration is under the threshold and the wheel spin is reduced under a slip threshold, applied brake pressure is reduced to get an optimum traction force.
- Outlet valve is open to release the brake pressure and inlet valve is closed to block the pressure increase from the motor pump.
- Hydraulic shuttle valve (HSV) remains opened, TC valve is ON.
- Motor is ON, to dump the brake fluid being released from the lock-up wheel.



LJCD021A

4. PRESSURE HOLD MODE

Solenoid valve	State	Valve	Motor pump	TC valve
Inlet (NO)	ON	CLOSE	ON	ON
Outlet (NC)	OFF	CLOSE		

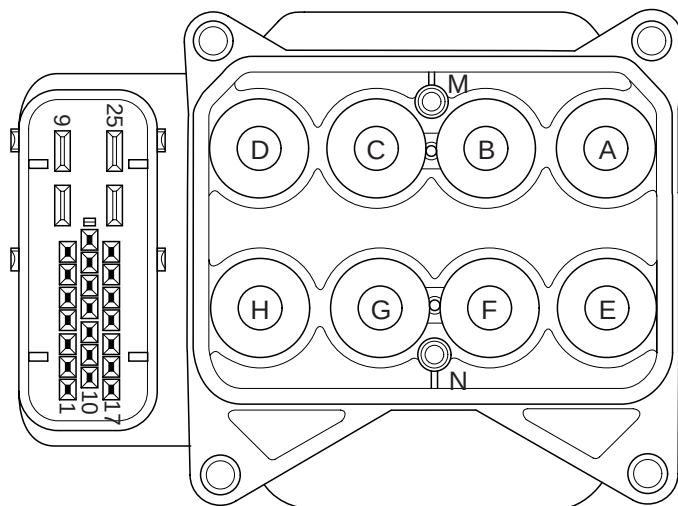


LJCD022A

HECU EXTERNAL DIAGRAM

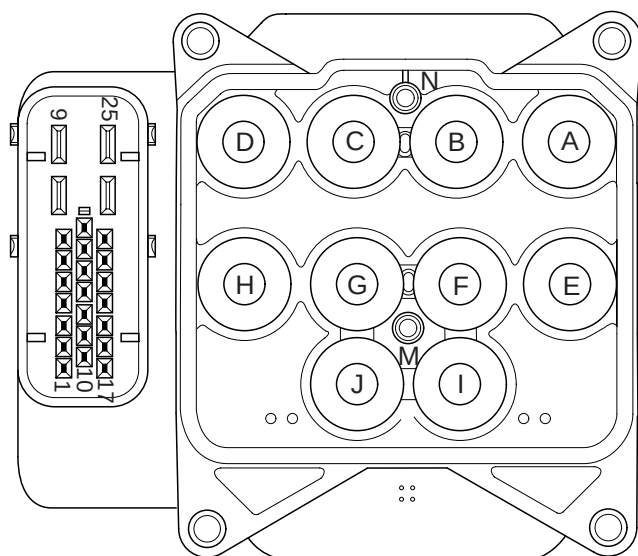
EE4984A0

[ABS ECU]



- A : INLET VALVE(FR)
- B : INLET VALVE(RL)
- C : INLET VALVE(RR)
- D : INLET VALVE(FL)
- E : OUTLET VALVE(FR)
- F : OUTLET VALVE(RL)
- G : OUTLET VALVE(RR)
- H : OUTLET VALVE(FL)
- M : MOTOR(+)
- N : MOTOR(GND)

[TCS ECU]



- A : INLET VALVE(FR)
- B : INLET VALVE(RL)
- C : INLET VALVE(RR)
- D : INLET VALVE(FL)
- E : OUTLET VALVE(FR)
- F : OUTLET VALVE(RL)
- G : OUTLET VALVE(RR)
- H : OUTLET VALVE(FL)
- I : TRACTION VALVE(TCR)
- J : TRACTION VALVE(TCL)
- M : MOTOR(+)
- N : MOTOR(GND)

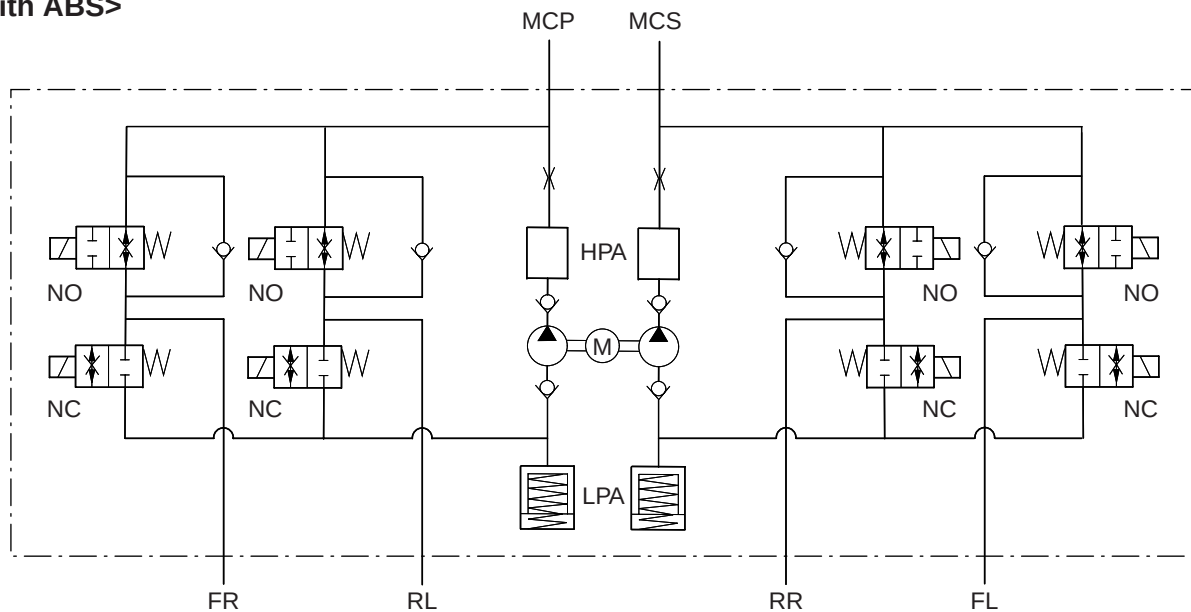
LJIF500P

ABS (ANTI-LOCK BRAKE SYSTEM)

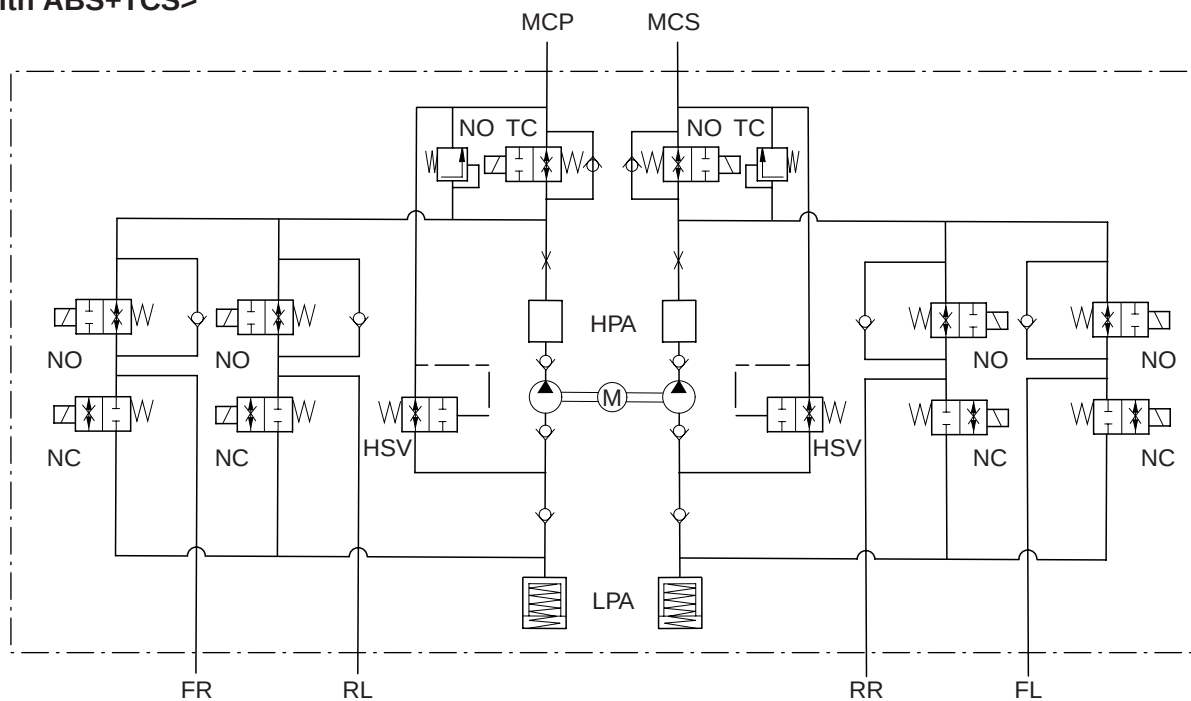
BR -65

HYDRAULIC SYSTEM DIAGRAM

<With ABS>



<With ABS+TCS>



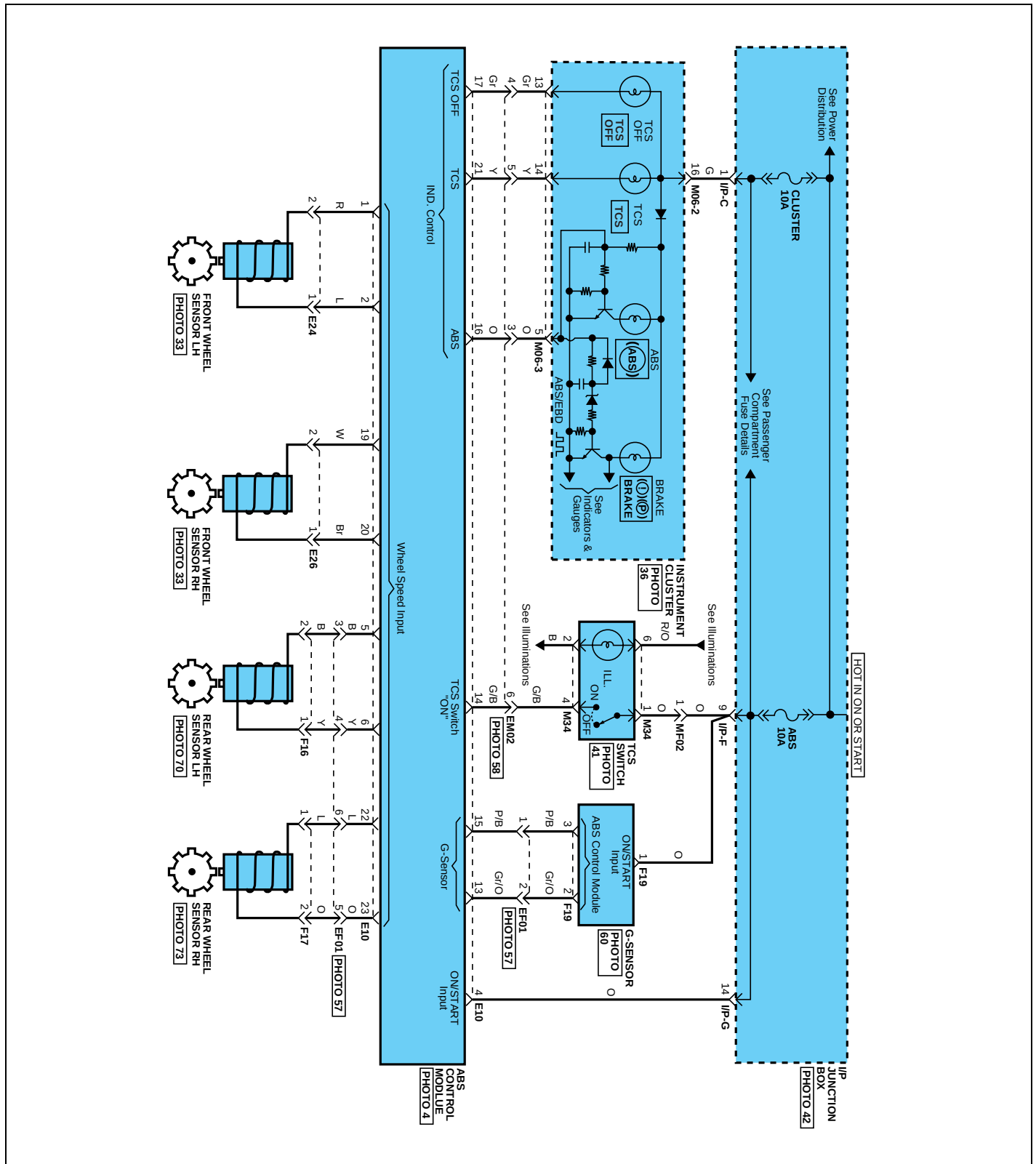
TCS : Traction Control System
MCP : Master Cylinder Primary
MCS : Master Cylinder Secondary
HPA : High Pressure Accumulator
LPA : Low Pressure Accumulator

M : Motor Pump
HSV : Hydraulic Shuttle Valve
TC : Traction Control valve
NO : Normal Open valve
NC : Normal Close valve

EJKD515A

CIRCUIT DIAGRAM(1)-ABS/TCS

EE9378D5



LJIF500Q

[illegible]

ABS/TCS CONNECTOR

INPUT/OUTPUT E3D6DBF2

Connector Terminal		Specification	Remark
No	Description		
4	IGNITION1(+)	Over voltage range: $16.5 \pm 0.5V$ Operating voltage range: $9.5 \pm 0.5V < V < 16.5 \pm 0.5V$ Low voltage range: $7.0 \pm 0.5V < V < 9.5 \pm 0.5V$ Max. current: $I < 300mA$	
25	POS. BATTERY.(SOLENOID)	Max leakage current : $I < 0.8mA$ Operating voltage range: $9.5 \pm 0.5V < V < 16.5 \pm 0.5V$ Max current : $I < 30A$	
9	POS, BATTERY.(MOTOR)	Operating voltage range: $9.5 \pm 0.5V < V < 16.5 \pm 0.5V$ Rush current : $I < 100A$ Max current : $I < 30A$ Max leakage current : $I < 0.2mA$	
8	GROUND	Rated current : $I < 300mA$ Max. current: $I < 30A$	
24	PUMP MOTOR GROUND	Rush current : $I < 100A$ Max current : $I < 30A$	
18	BRAKE LIGHT SWITCH	Input voltage low: $0V \leq V \leq 3.0V$ Input voltage High: $7.0V \leq V \leq 16.0V$	
3	SENSOR FRONT RIGHT OUTPUT	Max current : $I < 2mA$ External pull up resister : $10K\Omega < R$ Output duty : $50 \pm 20\%$	
16	ABS/EBD W/LAMP DRIVE	Max. current: $I < 200mA$ Max. output low voltage : $V < 1.2V$	
17	TCS W/LAMP DRIVE		with TCS
21	TCS F/LAMP DRIVE		with TCS
14	TCS ON/OFF SWITCH	- Input voltage low: $0V \leq V \leq 3.0V$ - Input voltage High: $7.0V \leq V \leq 16.0V$ - Max input current: $I < 10mA$	with TCS
11	CAN BUS LINE(HIGH)	Max. current : $I < 10mA$	with TCS
10	CAN BUS LINE(LOW)		
1	SENSOR FRONT LEFT POWER	- Output voltage : $IGN[V] \pm 1V$ - Output current : Max 30mA	
19	SENSOR FRONT RIGHT POWER		
5	SENSOR REAR LEFT POWER		
23	SENSOR REAR RIGHT POWER		

ABS (ANTI-LOCK BRAKE SYSTEM)

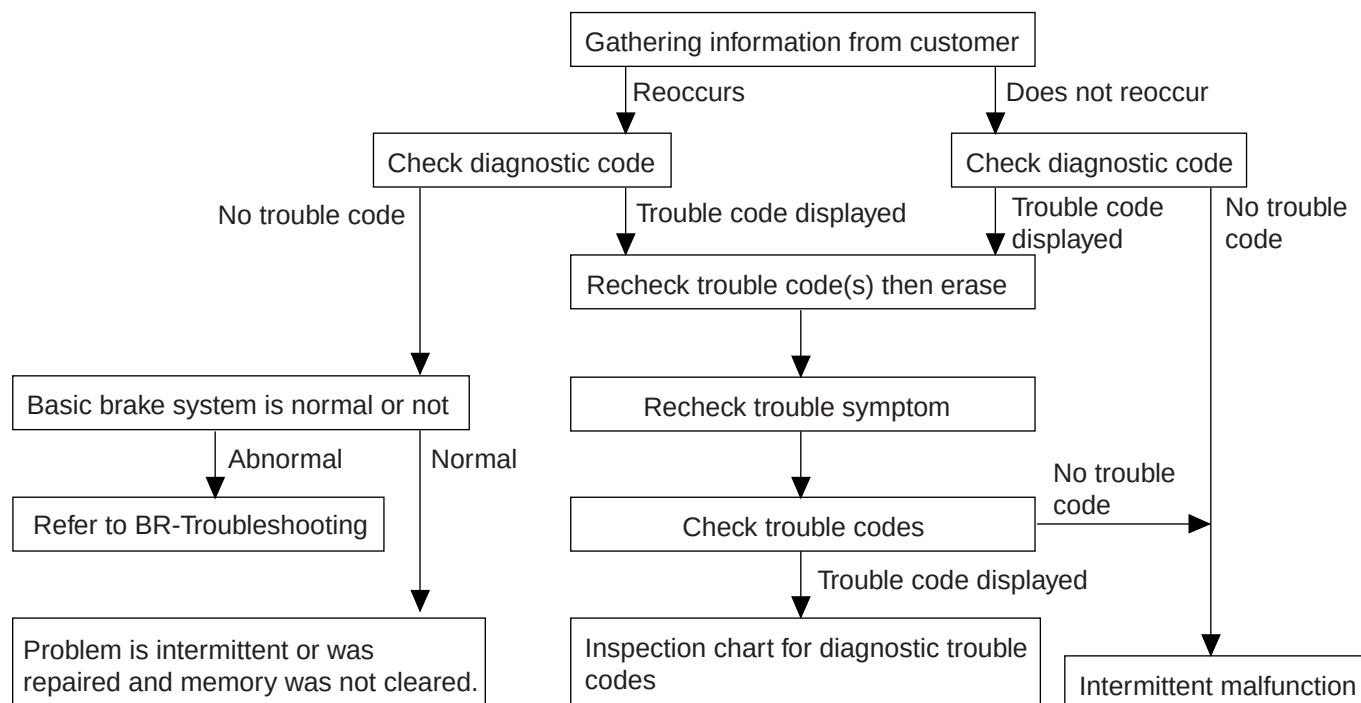
BR -69

Connector Terminal		Specification	Remark
No	Description		
2	SENSOR FRONT LEFT SIGNAL	- Input current LOW : 5.9 ~8.4 mA - Input current HIGH : 11.8 ~ 16.8 mA - Frequency range : 1 ~ 2000 Hz - Input duty : 50 ±20%	
20	SENSOR FRONT RIGHT SIGNAL		
6	SENSOR REAR LEFT SIGNAL		
22	SENSOR REAR RIGHT SIGNAL		
21	ABS ACTIVE SIGNAL	Max. current : $I < 200\text{mA}$	with 4WD
13	G SENSOR SIGNAL	Input Voltage : $0 \leq V \leq 5.0\text{V}$	with 4WD
15	G SENSOR GROUND	Rated current : $I < 10\text{mA}$	
7	DIAGNOSIS INPUT/OUTPUT	Input voltage : $V_{IL} < 0.3 \text{ IGN[V]}$ $V_{IH} > 0.7 \text{ IGN[V]}$ Output voltage : $V_{OL} < 0.2 \text{ IGN[V]}$ $V_{OH} > 0.8 \text{ IGN[V]}$	

TROUBLESHOOTING

E15AC2E3

STANDARD FLOW OF DIAGNOSTIC TROUBLESHOOTING



* Using the customer problem analysis check sheet for reference, ask the customer as much detail as possible about the problem.

EJKB055A

NOTES WITH REGARD TO DIAGNOSIS

The phenomena listed in the following table are not abnormal.

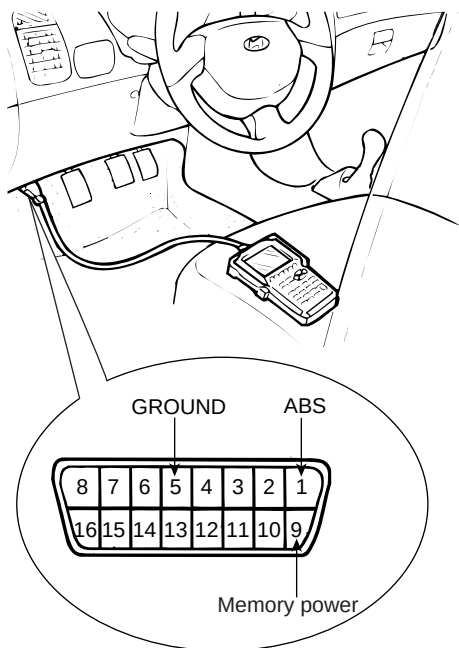
Phenomenon	Explanation
System check sound	When starting the engine, a thudding sound can sometimes be heard coming from inside the engine compartment. This is because the system operation check is being performed.
ABS operation sound	1. Sound of the motor inside the ABS hydraulic unit operation (whine). 2. Sound is generated along with vibration of the brake pedal (scraping). 3. When ABS operates, sound is generated from the vehicle chassis due to repeated brake application and release (Thump : suspension; squeak: tires)
ABS operation (Long braking distance)	For road surfaces such as snow-covered and gravel roads, the braking distance for vehicles with ABS can sometimes be longer than that for other vehicles. Accordingly, advise the customer to drive safely on such roads by lowering the vehicle speed.
Diagnosis detection conditions can vary depending on the diagnosis code. When checking the trouble symptom after the diagnosis code has been erased, ensure that the requirements listed in "Comment" are met.	

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -71

HI-SCAN (PRO) CHECK

1. Turn the ignition switch OFF.
2. Connector the Hi-scan(pro) to the 16P data link connector located the driver'd side kick panel.



EJKD057A

3. Turn the ignition switch ON.
4. Check for diagnostic trouble using the Hi-scan(pro)
5. After completion trouble of the repair or correction of the problem, erase the stored fault codes the clear key on the Hi-scan(pro).
6. Disconnect the Hi-scan(pro) from the 16P data link connector.

ABS CHECK SHEET

ABS Check Sheet

Inspector's
Name _____

Customer's Name		Registration No.	
		Registration Year	/ /
		VIN.	
Date Vehicle Brought In	/ /	Odometer	Km Miles

Date the Problem First Occurred	/ /
Frequency of Occurrence of Problem	☐ Continuous ☐ Intermittent (times a day)

Symptoms	☐ ABS does not operate.	
	☐ ABS does not operate efficiently.	☐ Intermittent (times a day)
	ABS Warning Light Abnormal	☐ Remains ON ☐ Does not light up

Diagnostic Trouble Code Check	1st Time	☐ Normal Code ☐ Malfunction Code (Code)
	2nd Time	☐ Normal Code ☐ Malfunction Code (Code)

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -73

PROBLEM SYMPTOMS TABLE

If a normal code is displayed during the DTC check but the problem still occurs, check the circuits for each problem symptom in the order given in the table below and proceed to the relevant troubleshooting page.

Symptom	Suspect Area	See page
ABS does not operate.	Only when 1. -4. are all normal and the problem is still occurring, replace the HECU. 1. Check the DTC reconfirming that the normal code is output. 2. Power source circuit. 3. Speed sensor circuit. 4. Check the hydraulic circuit for leakage.	BR - 75
ABS does not operate intermittently.	Only when 1. -4. are all normal and the problem is still occurring, replace the ABS actuator assembly. 1. Check the DTC reconfirming that the normal code is output. 2. Wheel speed sensor circuit. 3. Stop lamp switch circuit. 4. Check the hydraulic circuit for leakage.	BR - 77
Communication with Hi-scan (pro) is not possible. (Communication with any system is not possible)	1. Power source circuit 2. Diagnosis line	BR - 79
Communication with Hi-scan (pro) is not possible. (Communication with ABS only is not possible)	1. Power source circuit 2. Diagnosis line 3. HECU	BR - 80
When ignition key is turned ON (engine OFF), the ABS warning lamp does not light up.	1. ABS warning lamp circuit 2. HECU	BR - 81
Even after the engine is started, the ABS warning lamp remains ON.	1. ABS warning lamp circuit 2. HECU	BR - 82
Brake warning lamp is abnormal.	1. Brake oil level sensor 2. Parking brake switch 3. Brake warning lamp circuit	BR - 83



CAUTION

During ABS operation, the brake pedal may vibrate or may not be able to be depressed. Such phenomena are due to intermittent changes in hydraulic pressure inside the brake line to prevent the wheels from locking and is not an abnormality.

ABS Does Not Operate

EJKD222A

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

1. Connect the Hi-Scan (pro) with the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.

Is the normal code output?

Yes

No

Erase the DTC and recheck using Hi-Scan (pro).

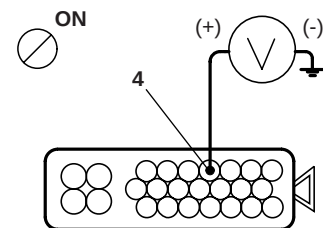
EJKD222B

2. CHECK THE POWER SOURCE CIRCUIT.

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 4 of the ABS control module harness side connector and body ground.

- **Specification: approximately B+**

Is the voltage within specification?



Yes

No

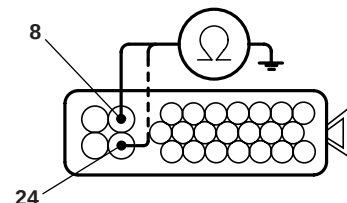
Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module. Repair if necessary.

LJIF500S

3. CHECK THE GROUND CIRCUIT.

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 8,24 of the ABS control module harness side connector and ground point.

Is there continuity?



Yes

No

Repair an open in the wire and ground point.

LJIF500T

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -75

4. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

OK

NG

Repair or replace the wheel speed sensor.

LJIF500U

5. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

OK

NG

Repair the hydraulic lines for leakage.

The problem is still occurring, replace the ABS control module.

LJIF500V

ABS Does Not Operate Intermittently

EJKD222G

1. CHECK THE DTC RECONFIRMING THAT THE NORMAL CODE IS OUTPUT.

1. Connect the Hi-Scan (pro) to the data link connector and turn the ignition switch ON.
2. Verify that the normal code is output.

Is the normal code output?

Yes

No

Erase the DTC and recheck using Hi-Scan (pro).

EJKD222H

2. CHECK THE WHEEL SPEED SENSOR CIRCUIT.

Refer to the DTC troubleshooting procedures.

OK

NG

Repair or replace the wheel speed sensor.

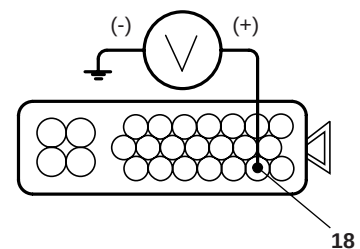
LJIF500W

3. CHECK THE STOP LAMP SWITCH CIRCUIT.

1. Check that stop lamp lights up when brake pedal is depressed and turns off when brake pedal is released.
2. Measure the voltage between terminal 18 of the ABS control module harness side connector and body ground when brake pedal is depressed.

- **Specification: approximately B+**

Is the voltage within specification?



Yes

No

Repair the stop lamp switch.
Repair an open in the wire between the ABS control module and the stop lamp switch.

LJIF500X

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -77

4. CHECK THE HYDRAULIC CIRCUIT FOR LEAKAGE.

Refer to the hydraulic lines.

OK

NG

Repair the hydraulic lines for leakage.

The problem is still occurring, replace the ABS control module.

LJIF500Y

Communication With Hi-Scan (pro) Is Not Possible.
(Communication With Any System Is Not Possible)

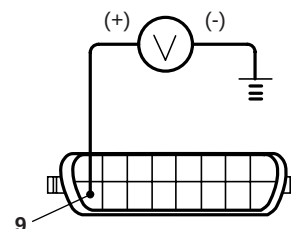
EJKD222L

1. CHECK THE POWER SUPPLY CIRCUIT FOR THE DIAGNOSIS

Measure the voltage between terminal 9 of the data link connector and body ground.

- **Specification: approximately B+**

Is voltage within specification?



Yes

No

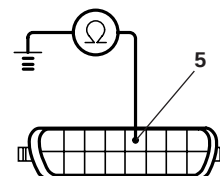
Repair an open in the wire.
Check and replace fuse (15A) from the passenger compartment junction block

LJIF500Z

2 . CHECK THE GROUND CIRCUIT FOR THE DIAGNOSIS

Check for continuity between terminal 5 of the data link connector and body ground.

Is there continuity?



No

Repair an open in the wire between terminal 5 of the data link connector and ground point.

LJIF501A

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -79

Communication With Hi-Scan (pro) Is Not Possible.
(Communication With ABS Only Is Not Possible)

EJKD222O

1. CHECK FOR CONTINUITY IN THE DIAGNOSIS LINE

1. Disconnect the connector from the ABS control module.
2. Check for continuity between terminals 7 of the ABS control module connector and 1 of the data link connector.

Is there continuity?

Yes

No

Repair an open in the wire.

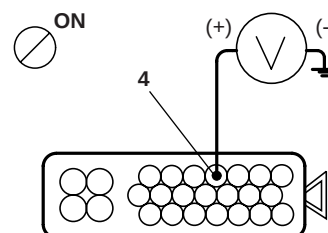
LJIF501B

2. CHECK THE POWER SOURCE OF ABS CONTROL MODULE

1. Disconnect the connector from the ABS control module.
2. Turn the ignition switch ON, measure the voltage between terminal 4 of the ABS control module harness side connector and body ground.

- **Specification: approximately B+**

Is voltage within specification?



Yes

No

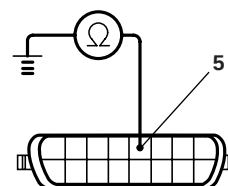
Check the harness or connector between the fuse (10A) in the passenger compartment junction block and the ABS control module.
Repair if necessary.

LJIF501C

3. CHECK FOR POOR GROUND

Check for continuity between terminal 5 of the data link connector and ground point.

Is there continuity?



Yes

No

Repair an open in the wire or poor ground.

Replace the ABS control module and recheck.

LJIF501D

When Ignition Key Is Turned ON (Engine OFF), The ABS Warning Lamp Does Not Light Up.

EJKD222S

1 . PROBLEM VERIFICATION

Disconnect the connector from the ABS control module and turn the ignition switch ON.

Does the ABS warning lamp light up?

No

Yes

Check for short circuit in the ABS control module connector.

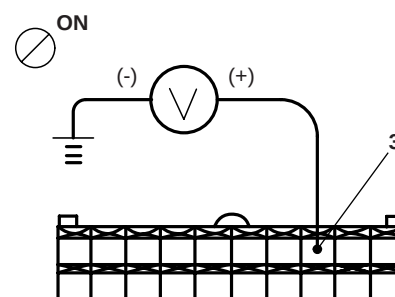
EJKD222T

2 . CHECK THE POWER SOURCE FOR THE ABS WARNING LAMP

1. Disconnect the instrument cluster connector and turn the ignition switch ON.
2. Measure the voltage between terminal 3 of the cluster harness side connector and body ground.

- Specification: approximately B+

Is voltage within specification?



No

Yes

Repair bulb or instrument cluster assembly.

LJIF501E

3 . CHECK FOR BLOWN FUSE

Check continuity of fuse (10A) from the passenger compartment junction block.

Is there continuity?

Yes

No

Replace the blown fuse.

Repair an open in the wire between terminals 12 of I/P-H connector and 3 of cluster connector.

LJIF501F

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -81

Even After The Engine Is Started, The ABS Warning Lamp Remains ON.

EJKD222W

1 . CHECK DTC OUTPUT.

1. Connect the Hi-Scan (pro) to the 16P data link connector located behind the driver's side kick panel.
2. Check the DTC output using Hi-Scan (pro).

Is DTC output?

No

Yes

Repair circuit indicated by code output.

EJKD222X

2 . CHECK INSTRUMENT CLUSTER

Disconnect the cluster connector and turn the ignition switch ON.

Does the ABS warning lamp remains ON?

No

Yes

Replace the instrument cluster.

LJIF501G

3 . CHECK FOR OPEN IN THE WIRE

Check for continuity in the wire between cluster and ABS control module.

Is there continuity?

Yes

No

Repair an open in the wire between cluster and ABS control module.

Replace the ABS control module and recheck.

EJKD222Z

Brake Warning Lamp Is Abnormal

EJKD223A

1. CHECK PARKING BRAKE SWITCH CIRCUIT

OK

NG

Repair or replace parking brake switch circuit.

EJKD223B

2. CHECK BRAKE OIL LEVEL WARNING SWITCH CIRCUIT

OK

NG

Repair or replace brake oil level warning switch circuit.

EJKD223C

3. CHECK BRAKE WARNING LAMP CIRCUIT IN CLUSTER

OK

NG

Repair or replace the instrument cluster.

EJKD223D

4. CHECK FOR OPEN OR SHORT CIRCUIT IN HARNESS AND CONNECTOR

OK

NG

Repair or replace the harness and connector.

Replace the ABS control module and recheck.

EJKD223E

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -83

BLEEDING OF BRAKE SYSTEM

This procedure should be followed to ensure adequate bleeding of air and filling of the ABS unit, brake lines and master cylinder with brake fluid.

1. Remove the reservoir cap and fill the brake reservoir with brake fluid.

 CAUTION

If there is any brake fluid on any painted surface, wash it off immediately.

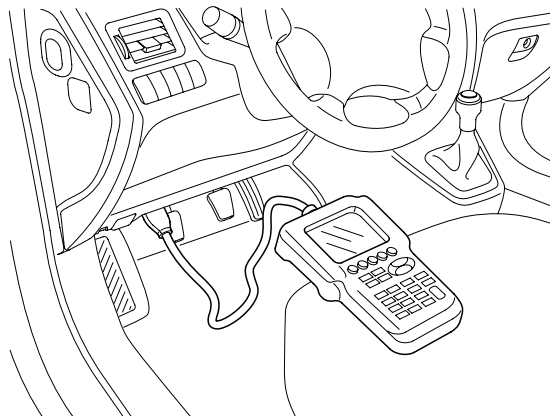
 NOTE

When pressure bleeding, do not depress the brake pedal.

Recommended fluid..... DOT3 or DOT4

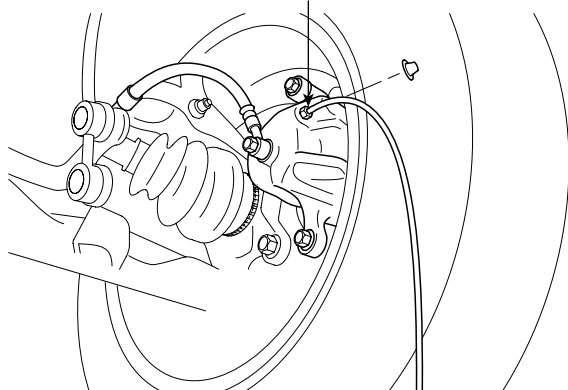
2. Connect a clear plastic tube to the wheel cylinder bleeder plug and insert the other end of the tube into a half filled clear plastic bottle.

3. Connect the hi-scan (pro) to the data link connector located underneath the dash panel.



KRQE900A

7~13 Nm (70~130 kgf·cm, 5.1~9.5 lbf·ft)



LJIF501H

4. Select and operate according to the instructions on the hi-scan (Pro) screen.



CAUTION

You must obey the maximum operating time of the ABS motor with the hi-scan (Pro) to prevent the motor pump from burning.

- 1) Select hyundai vehicle diagnosis.
- 2) Select vehicle name.
- 3) Select Anti-Lock Brake system.
- 4) Select air bleeding mode.
- 5) Press "YES" to operate motor pump and solenoid valve.

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	CLOSE
02. MOTOR PUMP STATUS	OFF
DO YOU WANT TO START ? (PRESS [YES] KEY)	

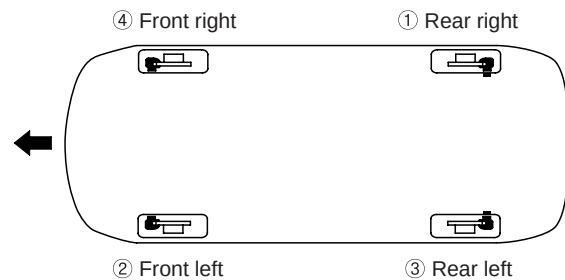
EJDA014F

- 6) Wait 60 sec. before operating the air bleeding.
(If not, you may damage the motor.)

1.6 AIR BLEEDING MODE	
ABS AIR BLEEDING STATUS	
01. SOLENOID VALVE STATUS	OPEN
02. MOTOR PUMP STATUS	ON
TIME : AUTOMATIC COUNT (1-60 SEC.)	

EJDA014G

5. Pump the brake pedal several times, and then loosen the bleeder screw until fluid starts to run out without bubbles. Then close the bleeder screw.
6. Repeat step 5 until there are no more bubbles in the fluid for each wheel.



KJKE003B

7. Tighten the bleeder screw.

Bleed screw tightening torque:

7~13 Nm (70 ~130 kg·cm, 5.1 ~ 9.5 lb·ft)

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -85

DIAGNOSTIC TROUBLE CODE CHART (DTC)



EBD △ - warning lamp "ON", in case of errors on more than 2 wheels.

Follow an inspection procedure of a detected DTC in the chart below.

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1101	Battery voltage high	○	○	○	○	○		BR-87
C1102	Battery voltage low	○	○	○	○	○		BR-87
C1200	Wheel speed sensor FR-LH open/short	○	○	○	○	○		BR-90
C1201	Wheel speed sensor FR-LH range/performance/intermittent	○	△	○	○	○		BR-92
C1202	Wheel speed sensor FR-LH invalid/no signal	○	△	○	○	○		BR-95
C1203	Wheel speed sensor FR-RH open/short	○	△	○	○	○		BR-90
C1204	Wheel speed sensor FR-RH range/performance/intermittent	○	△	○	○	○		BR-92
C1205	Wheel speed sensor FR-RH invalid/no signal	○	△	○	○	○		BR-95
C1206	Wheel speed sensor RR-LH open/short	○	△	○	○	○		BR-90
C1207	Wheel speed sensor RR-LH range/performance/intermittent	○	△	○	○	○		BR-92
C1208	Wheel speed sensor RR-LH invalid/no signal	○	△	○	○	○		BR-95
C1209	Wheel speed sensor RR-RH open/short	○	△	○	○	○		BR-90
C1210	Wheel speed sensor RR-RH range/performance/intermittent	○	△	○	○	○		BR-92
C1211	Wheel speed sensor RR-RH invalid/no signal	○	△	○	○	○		BR-95
C1604	ECU hardware error	○	○	○	○	○		BR-98
C2112	Valve relay error	○	○	○	○	○		BR-99
C2380	ABS/TCS/ESP valve error	○	○	○	○	○		BR-102
C2402	Motor - electrical	○	×	○	○	○		BR-104
C1274	G sensor - electrical	○	×	○	○	○	4WD	BR-107
C1275	G sensor - signal	○	×	○	○	○	4WD	BR-109
C1503	TCS switch error	×	×	○	○	○	TCS/ESP	BR-111
C1605	CAN hardware error	×	×	○	○	○	TCS/ESP	BR-113
C1611	CAN time-out EMS	×	×	○	○	○	TCS/ESP	BR-114
C1612	CAN time-out TCU	×	×	○	○	○	TCS/ESP	BR-116

DTC	DESCRIPTION	WARNING LAMP "ON"				DTC MEMORY	REMARK	SEE PAGE
		ABS	EBD	TCS	ESP			
C1613	CAN wrong message	×	×	○	○	○	TCS/ESP	BR-118
C1616	CAN bus off	×	×	○	○	○	TCS/ESP	BR-119
C2227	Excessive temperature of brake disc	×	×	○	○	○	TCS/ESP	BR-121
C1112	Sensor source voltage	×	×	○	○	○	ESP	BR-122
C1235	Pressure sensor(primary) - electrical	×	×	×	○	○	ESP	BR-123
C1237	Pressure sensor(secondary) - electrical	×	×	×	○	○	ESP	BR-125
C1259	Steering angle sensor - electrical	×	×	×	○	○	ESP	BR-127
C1260	Steering angle sensor - signal	×	×	×	○	○	ESP	BR-129
C1282	Yaw rate & lateral G sensor - electrical	×	×	×	○	○	ESP	BR-131
C1283	Yaw rate & lateral G sensor - signal	×	×	×	○	○	ESP	BR-133
C1513	Brake switch error	×	×	×	○	○	ESP	BR-136

**DTC C1101 BATTERY VOLTAGE OUT OF RANGE(OVER-VOLTAGE FAULT),
C1102 LOW-VOLTAGE FAULT**

DESCRIPTION E72E6AC6

This code shows in case that the power source for the HECU drops lower than or rises higher than the specified value. If the power source returns within the specified value, this code will not show any longer.



CAUTION

Before carrying out the following inspection, check and recharge, if necessary, the battery.

DTC DETECTING CONDITION E81E34DA

DTC No	Condition	Possible Cause
C1101 (High Voltage) C1102 (Low Voltage)	High Voltage: 1. When Vign more than $16\pm0.5V$ is continued for 500msec. 2. When Vign more than $19\pm0.5V$ is continued for 49msec. 3. if the voltage recover normal operating range, the controller is reset Low Voltage : 1. When Vign less than $9.5V\pm0.5V$ is continued for 500msec during Vref more than or equal to 7Km/h. 2. When Vign less than $8.5V\pm0.5V$ is continued for 500msec during Vref less than or equal to 7Km/h or ABS, TCS(ESP) control. 3. When Vign less than $7.2V\pm0.5V$ is continued for 28msec. 4. If IGN voltage is recovered to normal operating voltage, the system recovers to normal state.	- Open/short in power supply circuit - Faulty power source - Faulty HECU

FAILSAFE FUNCTION

High voltage :

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

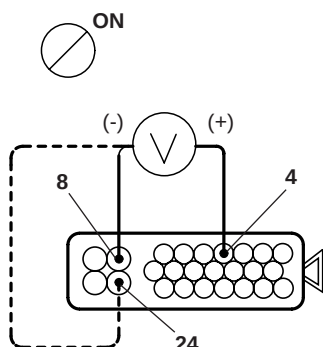
Low voltage :

1. Without the ABS control : inhibit the ABS, TCS(ESP) control of front wheels and allow the ABS control of rear wheels, deactivating the motor, and the ABS, TCS(ESP) warning lamps are switched on. When the voltage recover to the normal operating range, enable ABS function and ABS, TCS(ESP) warning lamps are switched off and erase the error code
2. With the ABS control : inhibit ABS control of the front wheels and allow ABS control of the rear wheels, deactivating the motor. the ABS, TCS(ESP) warning lamps are directly switched on and the state keeps continuously. the error code is always stored.

INSPECTION PROCEDURE EDF0B167

1. CHECK POWER BETWEEN TERMINAL OF HECU CONNECTOR.
 - 1) Disconnect the connector from the ABS control module, and then turn the ignition switch ON.
 - 2) Measure the voltage between terminals 4(+) and 8(-) or 24(-) of the HECU connector.

Specification: 9.4~17V



EJQE900H

Is the voltage within the specification?

YES

►Check the HECU connector.If no error is founded, replace the HECU and recheck.

NO

►Check battery.

2. CHECK BATTERY.

Measure the voltage between positive(+) and negative(-) terminals of the battery.
Is the voltage below 9.4V?

YES

►Check and replace the battery.

NO

►Check circuit for continuity between battery and HECU.

3. CHECK CIRCUIT FOR CONTINUITY BETWEEN BATTERY AND HECU.

Check the resistance between terminal 4(+) of the HECU connector and battery positive(+) terminal.
Is the resistance below 1Ω ?

NO

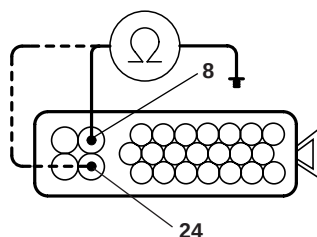
►Repair harness or connector.

YES

►Check circuit for continuity between the HECU and body ground.

4. CHECK CIRCUIT FOR CONTINUITY BETWEEN THE HECU AND BODY GROUND.

Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

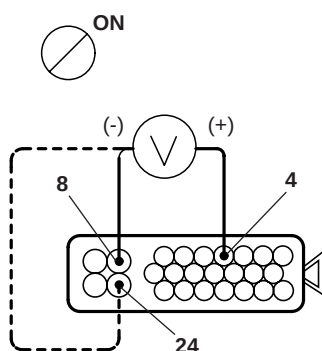
► Check and readjust the installing of the body ground.

YES

► Check voltage between the HECU connector.

5. CHECK VOLTAGE BETWEEN THE HECU CONNECTOR.

- 1) Turn the ignition switch ON.
- 2) Measure the voltage between terminals 4(+) and 8(-), 24(-) of the HECU connector.



EJQE900H

Is the voltage above 17V?

YES

► Repair and replace, if necessary, the charging system.

NO

► Repeat the inspection procedure.

DTC C1200 FL SENSOR-OPEN/SHORT, C1203 FRONT RIGHT, C1206 REAR LEFT, C1209 REAR RIGHT

DESCRIPTION EFA5BC32

The HECU receives wheel speed signals from the four wheel speed sensors. The wheel signals are converted to voltage signals by the signal converting circuit and given as input to the HECU. The HECU checks an open or short in the circuit of the wheel speed sensor. If more than one wheel speed sensor malfunctions, the system stops.

DTC DETECTING CONDITION E4C4AD7A

DTC No	Condition	Possible Cause
C1200 (FL) C1203 (FR) C1206 (RL) C1209 (RR)	*Active Sensor ; If the sensor signal current is continuously out of the specified range of 4 mA $\pm 10\%$ ~ 22 mA $\pm 10\%$ for 140msec, the failure is detected. * Passive Sensor ; When the offset voltage of the sensor is outside the specified range of 2V $\pm 10\%$ ~ 4V $\pm 10\%$ for 140msec, the failure is detected.	- Open/short in circuit of wheel speed sensor - Faulty wheel speed sensor - Faulty HECU

FAILSAFE FUNCTION

Sensor malfunction without ABS control :

- One wheel sensor malfunction

Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.

- More than two wheels malfunction

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

Sensor malfunction with ABS control :

- One front wheel malfunction

Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.

After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON but the EBD warning lamp is OFF.

- One rear wheel malfunction

Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased. After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON but the EBD warning lamp is OFF.

- More than two wheels malfunction

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EABB738B

1. CHECK POWER FOR WHEEL SPEED SENSOR

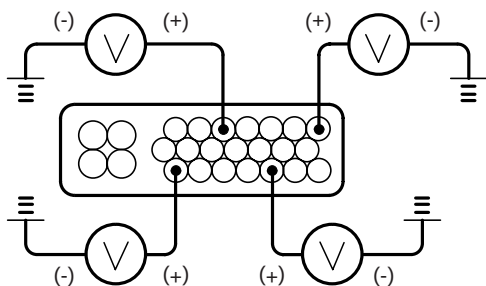
Measure the voltage between an appropriate wheel sensor(+) terminal and the body ground (see the table below).

DTC	Terminal
C1200 (Front-left)	1
C1203 (Front-right)	19
C1206 (Rear-left)	5
C1209 (Rear-right)	23

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -91

Specification: Battery positive(+)



KJQE900K

Is the voltage within the specification?

NO

► Repair short to power in the (+) circuit between the HECU and the appropriate wheel sensor.

YES

► Check output of the wheel speed sensor

2. CHECK OUTPUT OF THE WHEEL SPEED SENSOR

Check the voltage between terminals (see the table below) of the HECU and the body ground.

DTC	Terminal
C1200 (Front-left)	2
C1203 (Front-right)	20
C1206 (Rear-left)	6
C1209 (Rear-right)	22

Specification: 0.4~2.2V

Is the voltage within the specification?

YES

► Replace the wheel sensor and recheck.

NO

► Repair the wire between the HECU and the wheel speed sensor.

DTC C1201 FL SNSR-RANGE/PERFORMANCE, C1204 FRONT RIGHT, C1207 REAR LEFT, C1210 REAR RIGHT

DESCRIPTION EADCB43

This code shows in case that a speed signal from any of the 4 wheel speed sensors does not match to the others at any speed.

DTC DETECTING CONDITION

DTC No	Condition	Possible Cause
C1201 (FL) C1204 (FR) C1207 (RL) C1210 (RR)	Speed Jump : This monitoring is performed for the period that the velocity of each wheel exceeds 2km/h. - Controller counts the number of the wheel acceleration of 100g[(25km/h) for 7ms]. When the numbers at one wheel exceed 56 times, or When the numbers at more two wheels exceed 5 times, controller recognize the failure. - Controller counts the number of the wheel acceleration of 40g[(10km/h) for 7ms]. When the numbers at one wheel exceed 126 times, or When the numbers at more two wheels exceed 20 times, controller recognize the failure. - Controller counts the number of the wheel deceleration of -100g[(-25km/h) for 7ms]. When the numbers at each wheel exceed 56 times, controller recognize the failure. - The wheel deceleration of ?100g[(-25km/h) for 7ms] causes the controller to start monitoring this failure and to compare the wheel velocity with the vehicle velocity from next cycle. When its difference of -100g is continued for more than 140msec, controller recognize the failure. - In case that any sensor failure at other wheel was already detected, When the numbers of 100g at each wheel exceed 5 times, or When the numbers of 40g at each wheel exceed 20 times, controller recognize the failure. - The counter of speed jump is cleared every 30min. Wrong Exciter : - Max. wheel velocity exceeds 20km/h and the wheel velocity is 40% of max. wheel velocity. if this condition is lasted for 2 minutes. - Max. wheel velocity exceeds 40km/h and the wheel velocity is 60% of max. wheel velocity. if this condition is lasted for 2 minutes. - Faulty installing of wheel speed sensor	- Open/short in circuit of wheel speed sensor - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -93

FAILSAFE FUNCTION

Sensor malfunction without ABS control :

- One wheel sensor malfunction

Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.

- More than two wheels malfunction

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

Sensor malfunction with ABS control :

- One front wheel malfunction

Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.

After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.

- One rear wheel malfunction

Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.

After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.

- More than two wheels malfunction.

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

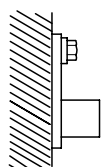
INSPECTION PROCEDURE

ED2816B9

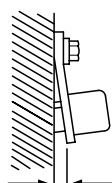
1. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.

Visually check the installing of wheel speed sensors and rotors.

Specification : 0.5~1.5mm



OK



NG

EJQE900L



NOTE

The mounting bolt shall be tightened properly and there is no clearance allowed between the sensor and front steering knuckle or rear axle carrier.

Is the air gap within the specification?

NO

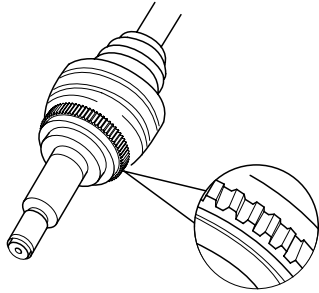
► Reinstall or replace, if necessary, wheel speed sensors in trouble.

YES

► Check sensor rotor and sensor tip.

2. CHECK SENSOR ROTOR AND SENSOR TIP

Check visually the sensor rotor and the sensor tip have scratches, missing teeth or foreign objects.



EJQE900M

Is it normal?

NO

- 1) Remove foreign objects from the sensor rotor and tip.
- 2) Replace the sensor rotor or the wheel speed sensor.

YES

► After clearing the DTC and driving the vehicle at 40km/h speed or more, if the TCS(ESP) lamp is ON and the same DTC shows again, replace the HECU and recheck.

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -95

DTC C1202 FL WHEEL SPEED SNSR-NO SIGNAL, C1205 FRONT RIGHT, C1208 REAR LEFT, C1211 REAR RIGHT

DESCRIPTION E187E256

This code shows in case that there is no signal from any of the wheel speed sensors caused by an air gap, etc.

DTC DETECTING CONDITION E37C66C4

DTC No	Condition	Possible Cause
C1202 (FL) C1205 (FR) C1208 (RL) C1211 (RR)	Large AirGap : This monitoring is performed for the period that the minimum velocity rises from 2km/h to 10km/h. - When the minimum wheel velocity is 2km/h and the velocity of other wheels exceed 10km/h with the less than acceleration of 0.4g, the controller start comparing the velocity of other wheels except the min. wheel. if their difference below 4km/h is continued for 140msec, Otherwise, if their difference beyond 4km/h or more than 0.4g is continued for 2 minutes. - In <0.4g, when the velocity of more than two wheels is 2km/h and the max. wheel velocity exceeds 10km/h, the condition is continued for 20 sec. Otherwise, In more than 0.4g, the condition is 2 minutes. - After velocity of 4 wheel exceeds 10km/h, when velocity of 1 wheel or 2 wheel is 2km/h and difference of other 2 wheel velocity is less than 4km/h under that those velocity is more than 10km/h, if that conditions are continued for 12 seconds. Long Term ABS mode : - During the ABS control cycle, if the wheel velocity of 2km/h is lasted for more than 12sec. - If the ABS control cycle is continued for more than 36sec.	- Faulty installing of wheel speed sensor - Open/short in circuit of wheel speed sensor - Faulty wheel speed sensor - Faulty rotor or wheel bearing - Faulty HECU

FAILSAFE FUNCTION

Sensor malfunction without ABS control :

- One wheel sensor malfunction

Only the ABS, TCS(ESP) functions are inhibited. the ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp is OFF.

- More than two wheels malfunction

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. the ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

Sensor malfunction with ABS control :

- One front wheel malfunction

Inhibit the ABS control of a wheel with a malfunctioning sensor and maintain the ABS control of other wheels.

After the ABS control has completed, the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.

- One rear wheel malfunction

Inhibit ABS control of both front wheels and the pressure of both rear wheels is decreased.

After the controller completes the ABS control, Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON and the EBD warning lamp is OFF.

- More than two wheels malfunction.

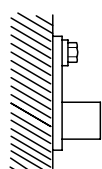
The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE

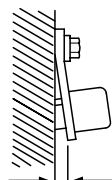
EAD8C340

1. CHECK AIR GAP BETWEEN WHEEL SPEED SENSOR AND TONE WHEEL.
Visually check the installing of wheel speed sensors and rotors.

Specification : 0.5~1.5mm



OK



NG

EJQE900L



NOTE

The mounting bolt shall be tightened properly and there is no clearance is allowed between the sensor and front steering knuckle or rear axle carrier.

Is the air gap within the specification?

NO

► Reinstall or replace if necessary, wheel speed sensors in trouble.

YES

► Check resistance between terminals of wheel speed sensor.

2. CHECK RESISTANCE BETWEEN TERMINALS OF WHEEL SPEED SENSOR.

- 1) Disconnect the HECU connector.

- 2) Measure the resistance between wheel speed sensors(+) and (-) circuit terminals.

Is the resistance within less than 1Ω ?

YES

- 1) There is a short in the circuit between the HECU and the wheel speed sensor.

- 2) Replace the wheel speed sensor.

NO

► Check speed of each wheel.

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -97

3. CHECK SPEED OF EACH WHEEL

Check if the speed of each of four wheel properly represents the speed of a vehicle, increasing the speed of the vehicle till 60km/h.

Is the speed of each wheel the same as that of the vehicle?

NO

- 1) Check any foreign objects on the rotor of the wheel in trouble.
- 2) Check if the sensor is genuine.

YES

After cleaning the DTC and driving the vehicle at 40 km/h speed or more, if the ABS warning lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1604 ECU HARDWARE ERROR

DTC DETECTING CONDITION

E8BC5A85

DTC No	Condition	Possible Cause
C1604	- When the MCU can't erase or write a data of the EEPROM. - If the master/slave processor detects abnormal operation in RAM, status register, interrupt, timer, A/D converter and cycle time.	- EEPROM Failure of HECU - MCU failure of HECU

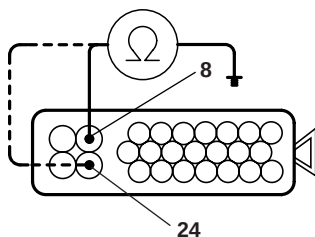
FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE

EB6ACBE6

1. CHECK CIRCUIT FOR CONTINUITY BETWEEN THE HECU AND BODY GROUND.



EJQE900J

Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.
Is the resistance below 1Ω ?

NO

- Check and readjust the installing of the body ground.

YES

- After cleaning the DTC and driving the vehicle at 40 km/h speed or more, if the ABS warning lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C2112 VALVE RELAY MAL.

DESCRIPTION EAEC09C

The HECU makes the valve relay OFF, when the ignition switch is turned ON, but ON during its initial check. The HECU checks the valve relay by checking the voltage of the valve power monitoring wire and comparing the signals from the valve relay. The HECU also checks continuity of the valve power monitoring wire.

DTC DESCRIPTION E98D49AB

This code shows in case that there is no continuity of the valve power monitoring wire.

DTC DETECTING CONDITION E14DC7A9

DTC No	Condition	Possible Cause
C2112	- If the valve relay is switched on and the reference voltage of valve relay, less than $5\pm0.5V$ continuously for 56ms, the failure is detected. - If the valve relay is switched off and the reference voltage of valve relay, more than $6\pm0.5V$ continuously for 56ms, the failure is detected. - If the valve relay is switched off and all solenoid drivers are switched off and reference voltage of valve relay, less than $2.5\pm0.5V$ continuously for 56ms, the failure is detected.	- Open/short in the valve relay circuit - Faulty HECU

FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

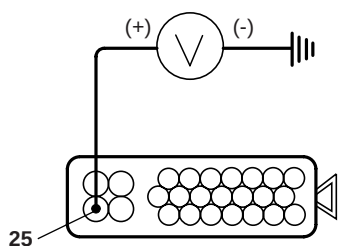
INSPECTION PROCEDURE

EFB92415

1. CHECK POWER SOURCE OF MOTOR.

- 1) Disconnect the connector from the HECU.
- 2) Measure the voltage between the terminals 25(+) and ground(-).

Specification: Battery positive(+)



LJIF5011

Is the voltage within the specification?

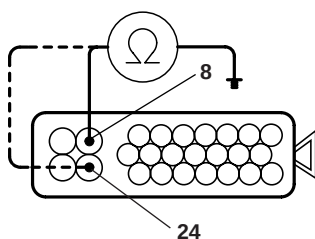
NO

- 1) Check ABS fuse (10A) and fusible link (40A).
- 2) Check and repair harness or connector.

YES

► Check circuit for continuity to ground.

2. CHECK CIRCUIT FOR CONTINUITY TO GROUND.



EJQE900J

- 1) Disconnect the connector from the HECU.
- 2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.

Is the resistance below 1Ω ?

NO

► Check and readjust the installing of the body ground.

YES

- ▶ Test motor actuation by using hi-scan (pro)

3. TEST MOTOR ACTUATION BY USING HI-SCAN (PRO).
Is the sound of motor operating heard?

YES

- ▶ Check repair, if necessary, harness and connector.

NO

- ▶ Replace the HECU then recheck.

DTC C2380 ABS/TCS/ESP VALVE ERROR

DESCRIPTION EF9E0A2A

The HECU monitors the solenoid valve operating circuit. If there is no continuity of the solenoid valve, when the HECU switches the solenoid valve ON, it is a cause an open or short in the circuit of the solenoid coil or harness.

DTC DESCRIPTION E1B43BFA

This code shows in case that there is an open or short in the circuit of the solenoid coil or harness.

DTC DETECTING CONDITION E6C58F04

DTC No	Condition	Possible Cause
C2380	- If the valve relay is switched ON and corresponding solenoid driver OFF and the voltage of solenoid, less than $3.5\pm0.5V$ continuously for 56ms, the failure is detected. - If the valve relay is switched ON and corresponding solenoid driver ON and the voltage of solenoid, more than $1.5\pm0.5V$ continuously for 56ms, the failure is detected.	- Open/short in the solenoid valve circuit. - Faulty HECU

FAILSAFE FUNCTION

The system stops. the ABS, TCS(ESP) and the EBD functions are inhibited. The ABS, TCS(ESP) and the EBD warning lamps are ON. The valve relay and all solenoids are OFF.

INSPECTION PROCEDURE EBBB5E1D

1. CHECK THE DTC

- 1) Clear the DTC using the Hi-Scan(pro).
- 2) Turn the ignition switch OFF.
- 3) Turn the ignition switch ON, and check if the same DTC is stored in the memory.

Is the same DTC output?

NO

- Problem is intermittent and the HECU memory was not cleared.

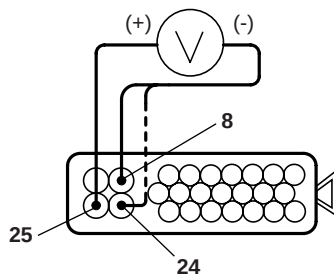
YES

- Check power source of valve relay

2. CHECK POWER SOURCE OF VALVE RELAY

- 1) Disconnect the connector from the HECU.
- 2) Measure the voltage between the terminals 25 and 8, 24 of the HECU connector.

Specification: Battery positive(B+)



EJQE900P

Is the voltage within the specification?

NO

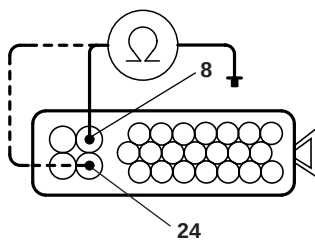
- 3) Check and replace fuse (10A) and fusible link (40A).
- 4) Check and repair harness or connector.

YES

► Check circuit for continuity to ground.

3. CHECK CIRCUIT FOR CONTINUITY TO GROUND.

- 1) Disconnect the connector from the HECU.
- 2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

► Check and readjust the installing of the body ground.

YES

► Replace the HECU then recheck.

DTC C2402 MOTOR-ELECTRICAL

DESCRIPTION E6DF293F

When the ABS system operates, the HECU turns the ABS motor relay ON so that the ABS pump motor is operated.

DTC DESCRIPTION E3266E63

This code is set when there is no signal to the motor monitoring wire or if there is an error with the motor power.



CAUTION

Keep the vehicle idling because the constant operation of the ABS motor while testing the actuator will shall cause the discharging of the battery, when testing the actuator.

DTC DETECTING CONDITION EA9A5CEF

DTC No	Condition	Possible Cause
C2402	[Motor relay open, motor short to GND] : - If the motor relay is switched ON and $V_{mr} < (V_{ign} - (4 \pm 0.5V))$ continued for 49msec, the failure is detected. [Motor open, motor short to BATT] : - After 1.8sec from the time that motor relay is switched OFF, $V_{mr} > 4 \pm 0.5V$ continued for 1.8sec, the failure is detected. [Motor lock] : - After motor relay is switched OFF, VMR is measured. If the time which $V_{mr} > 1 \pm 0.1V$ is less than evaluation time, recheck is performed again for a maximum of three times. When VMR is not normal even on the third recheck, the controller recognizes it as failure. If the motor relay is switched OFF and motor power supply voltage $< 4V$ continued for 200ms, the failure is detected. [Motor fuse open] : - If the motor relay is switched OFF and $V_{mrp} < 4 \pm 0.5V$ continued for 1sec, the failure is detected.	- Open/short in motor relay or motor circuit. - Motor lock - Faulty HECU

FAILSAFE FUNCTION

1. Motor error without the ABS control : only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.
2. Motor error with the ABS control : inhibit the ABS control of front wheels, allow ABS control of the rear wheels. After the ABS control has completed, the ABS, TCS(ESP) warning lamps are ON.

ABS (ANTI-LOCK BRAKE SYSTEM)

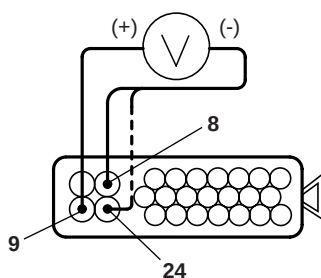
BR -105

INSPECTION PROCEDURE E42C81EF

1. CHECK POWER SOURCE OF MOTOR.

- 1) Disconnect the connector from the HECU.
- 2) Measure the voltage between the terminals 9(+) and 8(-), 24(-) of the HECU connector.

Specification: Battery positive(+)



LJIF501Z

Is the voltage within the specification?

NO

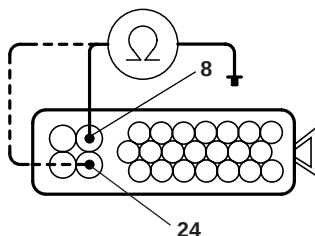
- 3) Check ABS fuse (10A) and fusible link (30A).
- 4) Check and repair harness or connector.

YES

► Check circuit for continuity to ground.

2. CHECK CIRCUIT FOR CONTINUITY TO GROUND.

- 1) Disconnect the connector from the HECU.
- 2) Measure the resistance between terminals 8(-), 24(-) of the HECU connector and the body ground.



EJQE900J

Is the resistance below 1Ω ?

NO

- ▶ Check and readjust the installing of the body ground.

YES

- ▶ Test motor actuation by using hi-scan (pro)

3. TEST MOTOR ACTUATION BY USING HI-SCAN (PRO).
Is the sound of motor operating heard?

YES

- ▶ Check repair, if necessary, harness and connector.

NO

- ▶ Replace the HECU then recheck.

DTC C1274 G SENSOR-ELECTRICAL

DTC DETECTING CONDITION

ECDA7F3B

DTC No	Condition	Possible Cause
C1274	When the voltage of Gsensor signal is more than 4.5V or less than 0.6V for 250msec continuously.	- Open/short in G-sensor circuit. - Faulty G-sensor - Faulty installation of G-sensor - Faulty HECU

FAILSAFE FUNCTION

Only the ABS, TCS(ESP) functions are inhibited. The ABS,TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.

INSPECTION PROCEDURE

EEFA8F98

1. CHECK SHORT IN CIRCUIT TO BATTERY(+).

- 1) Disconnect the connector from the HECU.
- 2) Turn the ignition switch ON.
- 3) Measure the voltage between terminal 13 of the HECU connector and the body ground.
Is the voltage above 4.5V?

YES

- Repair short in the circuit to battery(+) between the G-sensor and the HECU.

NO

- Check short in circuit to ground.

2. CHECK SHORT IN CIRCUIT TO GROUND.

- 1) Disconnect the connector from the HECU.
- 2) Measure the resistance between terminal 13 of the HECU connector and the body ground.
Is the resistance below 1Ω ?

YES

- Repair short in the circuit to the body ground between the G-sensor and the HECU.

NO

- Check output in HECU connector

3. CHECK OUTPUT IN HECU CONNECTOR.

- 1) Disconnect the connector from the HECU and turn the ignition switch ON.
- 2) Measure the voltage between terminals 13(+) and 15(-) of the HECU connector.
Is the voltage within 0.6V ~ 4.5V?

YES

► Check the HECU harness or connector.

NO

► If necessary, replace the HECU then recheck.

4. CHECK OUTPUT IN G-SENSOR CONNECTOR.

- 1) Turn the ignition switch ON.
- 2) Measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification: approximately 3.5V

Is the voltage within the specification?

NO

► Replace the G-sensor.

YES

► Replace the HECU then recheck.

DTC C1275 G SENSOR-SIGNAL

DTC DETECTING CONDITION

E7BE2F36

DTC No	Condition	Possible Cause
C1275	- When vehicle speed is more than 10km/h and the brake light switch is off, ' $G > 0.5G$ ' for 20sec continuously. - When ' $min. \text{ wheel speed} / dt \geq 0.2G$ and $G \leq 0.1G$ ' for 60sec continuously.	- Open/short in G-sensor circuit. - Faulty G-sensor - Faulty installation of G-sensor - Faulty HECU

FAILSAFE FUNCTION

Only the ABS, TCS(ESP) functions are inhibited. The ABS, TCS(ESP) warning lamps are ON, but the EBD warning lamp OFF.

INSPECTION PROCEDURE

E89704AC

1. CHECK OPEN/SHORT IN CIRCUIT OF G-SENSOR.

- 1) Turn the ignition switch ON.
- 2) Measure the output voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Is the voltage within 0.6V ~ 4.5V?

NO

- Repair an open or short in the circuit between the G-sensor and the HECU.

YES

- Check installation of G-sensor

2. CHECK THE INSTALLATION OF G-SENSOR

Visually check for the installation of the G-sensor.

Be sure to install the G-sensor with the arrow mark to be facing forward direction.

Is it installed correctly?

NO

- Reinstall the G-sensor and recheck.

YES

- Check output voltage in G-sensor connector

BR -110

BRAKE SYSTEM

3. CHECK OUTPUT VOLTAGE IN G-SENSOR CONNECTOR.

Turn the ignition switch ON.

Measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification : approximately 2.5V

Incline the G-sensor to 90 degrees angle then measure the voltage between terminals 2(+) and 3(-) of the G-sensor connector.

Specification : approximately 3.5V

Is the voltage within the specification?

NO

► Replace the G-sensor.

YES

► Replace the HECU then recheck.

DTC C1503 TCS SWITCH ERROR

DESCRIPTION EA03A577

The TCS(ESP) OFF switch is for ON/OFF of TCS(ESP) function.
When the TCS(ESP) OFF switch is pushed, the TCS(ESP) system stops and the TCS(ESP) OFF lamp is ON.

DTC DETECTING CONDITION E3E7E682

DTC No	Condition	Possible Cause
C1503	When the TCS/ESP switch is ON for 1 min.	- Open/short in TCS/ESP switch circuit. - Faulty TCS/ESP switch - Faulty HECU

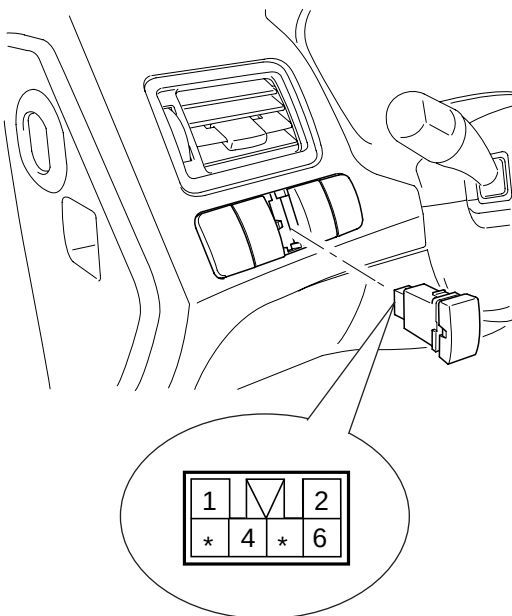
FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EACB53FF

1. CHECK TCS(ESP) OFF SWITCH

- 1) Remove the TCS(ESP) OFF switch from the panel of the driver's side crash pad.
- 2) Check for the continuity between the TCS(ESP) OFF switch terminals, when the TCS(ESP) OFF switch is ON.



LJIF501J

Is there continuity between terminals 1 and 4 of the TCS (ESP) switch connector?

Terminal Function	1	4	6	2
ON				
OFF				

LJIF501K

NO

- Replace with a new TCS(ESP) OFF switch.

YES

- Check short in circuit of TCS/ESP Switch

2. CHECK SHORT IN CIRCUIT OF TCS/ESP SWITCH

- 1) Remove the TCS(ESP) OFF switch from the panel of the driver's side crashpad.
- 2) After the ignition switch is ON, measure the voltage between terminal 4 of the TCS(ESP) OFF switch connector and the body ground.

Specification : Battery positive (B+)

Is the voltage within the specification?

NO

- (1) Check and replace fuse(10A).
- (2) Check and repair harness and connector.

YES

- Check open/short in circuit between TCS(ESP) OFF switch and the HECU.

3. CHECK OPEN/SHORT IN CIRCUIT BETWEEN TCS(ESP) OFF SWITCH AND THE HECU

Check an open or short in the circuit between terminal 4 of TCS(ESP) OFF switch connector and terminal 14 (ESP:27) of the HECU connector.

Is the circuit normal?

NO

- Check and repair the circuit between the switch and the HECU.

YES

- After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the TCS(ESP) lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1605 CAN CONTROL HARDWARE ERROR

DESCRIPTION EFF85DB3

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU.

DTC DESCRIPTION E863AF39

This code shows in case that there is an error on the CAN hardware. In this case, replace the HECU and check.

DTC DETECTING CONDITION ECDAED3A

DTC No	Condition	Possible Cause
C1605	In case that CAN has hardware failure.	- Faulty CAN bus

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1611 CAN TIME OUT-EMS

DESCRIPTION ED29A274

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU. This code shows in case that there is no signal to the CAN from EMS.

DTC DETECTING CONDITION ED68F1D5

DTC No	Condition	Possible Cause
C1611	1. In case that EMS1 or EMS2 message was not received for more than 500ms within normal voltage condition. 2. The monitoring starts 2000 ms after power up.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty EMS - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EAE95850

1. CHECK DTC DETECTED IN HI-SCAN

- 1) Clear the DTC related to the CAN, from the EMS or TCU by using the HI-SCAN.
- 2) Check if any DTC related to the CAN is detected again, when the ignition switch ON.

Is any DTC related to the CAN, detected again?

NO

- Problem is intermittent and the HECU memory was not cleared.

YES

- Check component.

2. CHECK COMPONENT

- 1) Ignition "OFF".
- 2) Ignition "ON"
- 3) Does warning lamp remain On ?

YES

► Substitute with a known-good EMS and check for proper operation. If problem is corrected, replace EMS and then go to "Verification of Vehicle Repair" procedure. If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.

NO

► Fault is intermittent caused by faulty EMS and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure. After a repair, it is essential to verify that the fault has been corrected.

3. VERIFICATION OF VEHICLE REPAIR

- 1) Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- 2) Using a scantool, Clear DTC.
- 3) Operate the vehicle within DTC Detecting Condition in General Information.
- 4) Are any DTCs present ?

YES

► Go to the applicable troubleshooting procedure.

NO

► System performing to specification at this time.

DTC C1612 CAN TIME OUT-TCU

DESCRIPTION E610209C

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU. This code shows in case that there is no signal to the CAN from TCU.

DRC DETECTING CONDITION EFABC46C

DTC No	Condition	Possible Cause
C1612	1. In case that TCU message was not received for more than 500ms within normal voltage condition. 2. The monitoring starts 2000 ms after power up.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty TCU - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE E3CE617B

1. CHECK DTC DETECTED IN HI-SCAN

- 1) Clear the DTC related to the CAN, from the EMS or TCU by using the HI-SCAN.
- 2) Check if any DTC related to the CAN is detected again, when the ignition switch ON.

Is any DTC related to the CAN, detected again?

NO

- Problem is intermittent and the HECU memory was not cleared.

YES

- Check component

2. CHECK COMPONENT

- 1) Ignition "OFF".
- 2) Ignition "ON"
- 3) Does warning lamp remain On ?

YES

► Substitute with a known-good TCU and check for proper operation. If problem is corrected, replace TCU and then go to "Verification of Vehicle Repair" procedure. If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.

NO

► Fault is intermittent caused by faulty TCU and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure. After a repair, it is essential to verify that the fault has been corrected.

3. VERIFICATION OF VEHICLE REPAIR

- 1) Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- 2) Using a scantool, Clear DTC.
- 3) Operate the vehicle within DTC Detecting Condition in General Information.
- 4) Are any DTCs present ?

YES

► Go to the applicable troubleshooting procedure.

NO

► System performing to specification at this time.

DTC C1613 CAN WRONG MESSAGE

DESCRIPTION E6ECCC81

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and EMS/TCU. This code shows in case that EMS misunderstands a vehicle with A/T to with M/T. In this case check if it is correct the information received from EMS by using the HI-SCAN.

DTC DETECTING CONDITION E454FDF8

DTC No	Condition	Possible Cause
C1613	1. In case that the information about transmission is different in the EMS2 and TCU within normal voltage condition. 2. The monitoring starts 2000 ms after power up.	- Faulty CAN bus - Faulty EMS or TCU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1616 CAN BUS OFF

DESCRIPTION EA7AA5ED

The CAN is for sending and receiving the information for TCS(ESP) control, between the HECU and ECM/TCM.

DTC DETECTING CONDITION EC3071B0

DTC No	Condition	Possible Cause
C1616	In case CAN BUS off state continued for more than 100ms.	- Open/short in CAN bus circuit. - Faulty CAN bus - Faulty HECU

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EF4AB9B5

1. CHECK COMPONENT

- 1) Ignition "OFF".
- 2) Ignition "ON"
- 3) Does warning lamp remain On ?

YES

► Substitute with a known-good TCU and check for proper operation. If problem is corrected, replace TCU and then go to "Verification of Vehicle Repair" procedure. If NG, replace HECU and then go to "Verification of Vehicle Repair" procedure.

NO

► Fault is intermittent caused by faulty TCU and/or faulty HECU or was repaired and HECU memory was not cleared. Go to the applicable troubleshooting procedure. After a repair, it is essential to verify that the fault has been corrected.

2. VERIFICATION OF VEHICLE REPAIR

- 1) Connect scantool and select "Diagnostic Trouble Codes(DTCs)" mode.
- 2) Using a scantool, Clear DTC.
- 3) Operate the vehicle within DTC Detecting Condition in General Information.
- 4) Are any DTCs present ?

YES

- Go to the applicable troubleshooting procedure.

NO

- System performing to specification at this time.

DTC C2227 EXCESSIVE TEMPERATURE OF BRAKE DISC

DESCRIPTION EB50966B

The TCS controls the brake by using the motor pump.
When the TCS operates, The TCS detects overheating of the brake disk.

DTC DETECTING CONDITION E2AFC14E

DTC No	Condition	Possible Cause
C2227	1.When the calculated temperature of disc is higher than 500°C. 2.If the calculated temperature drops below 300°C, the controller recovers to normal state. 3.When IGN switched OFF, ECU calculate temperature of disc until calculated temperature drops below 80°C by BATT1 power.	- Brake disc over working

FAILSAFE FUNCTION

The TCS/ESP function is inhibited, while the ABS and EBD controls allowed.
The TCS/ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1112 SENSOR SOURCE VOLTAGE

DTC DETECTING CONDITION

EBD13C2B

DTC No	Condition	Possible Cause
C1112	[Abnormal sensor power] : - During sensor power ON, If the voltage of sensor power is out of the range of $5\pm0.5V$ for 500ms, The failure is recognized. - During sensor power OFF, If the voltage of sensor power is out of the range of $0.5\pm0.1V$ for 500ms, The failure is recognized. - If the YAW or lateral sensor signal pin has a short circuit to a battery, The failure is recognized.	- Faulty Sensor Power - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

DTC C1235 PRESSURE SENSOR-ELECTRICAL

GENERAL DESCRIPTION E7C739DF

Master cylinder pressure sensor is used for detecting the pressure delivered to wheels when the brake system is working.

DTC DESCRIPTION EF021FEA

This code sets when there is an open or short in the circuit of the pressure sensor.

DTC DETECTING CONDITION EBD8367C

DTC No.	Detecting Condition	Possible Cause
C1235	[Open, short to BATT/GND] - When $V_{mcp} > 4.8 \pm 0.1V$ or $V_{mcp} < 0.2 \pm 0.1V$ continue 1sec, - When sensor self test form is against to sensor specification - While the vehicle is stopped after driving over 40KPH for 3 times, If predefined value of pressure signal is not detected, ECU detect the failure after sensor self test. - The monitoring starts 1sec after power up.	- Open/Short in the pressure sensor circuit - Faulty the pressure sensor - Faulty installation of the pressure sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EDE2DC8B

1. CHECK INSTALLATION OF PRESSURE SENSOR

- 1) Check if the pressure sensor is properly installed on the master cylinder.
Is the pressure sensor installed properly?

NO

► Reinstall the pressure sensor properly.

YES

► Check power to the pressure sensor

2. CHECK POWER TO THE PRESSURE SENSOR

- 1) Disconnect the pressure sensor connector, and measure the voltage between terminals 1(-) and 3(+) of the pressure sensor connector.

Specification : 4.8~5.2 V

Is the voltage within the specification?

NO

- ▶ Check harness and connector between the HECU and the pressure sensor.

YES

- ▶ Check output voltage of pressure sensor

3. CHECK OUTPUT VOLTAGE OF PRESSURE SENSOR

- 1) Measure the voltage between terminal 2 of the pressure sensor connector and the body ground.

Specification : 0.5~4.5V

Is the output voltage within the specification?

NO

- ▶ Check harness and connector of the pressure sensor. If there is no error on the harness and the connector, replace the pressure sensor and recheck.

YES

- ▶ Check output voltage of HECU connector

4. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR

- 1) Measure the voltage between terminal 12 of the HECU connector and the body ground.

Specification : 0.5~4.5V

Is the voltage within the specification?

NO

- ▶ Repair harness and connector between the HECU and the pressure sensor.

YES

- ▶ After clearing the DTC and driving the vehicle at 40Km/h or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1237 PRESSURE SENSOR-SIGNAL FAULT

GENERAL DESCRIPTION EE9869AE

Master cylinder pressure sensor is used for detecting the pressure delivered to wheels when the brake system is working.

DTC DESCRIPTION E5E8D9BD

This code sets when there is an irregular or no signal of the pressure sensor.

DTC DETECTING CONDITION EBCB3621

DTC No.	Detecting Condition	Possible Cause
C1237	[Noisy signal, offset, stick] - If input signal is noisy, Which the gradient of the sensor signal is larger than 15bar over 25times in 2sec, ECU detect the failure. - Outside an ABS/TCS/ESP control, And after normal operation of BLS, If the pressure sensor signal is higher than 20bar and BLS is low for 3sec, ECU detect the failure.	- Open/Short in the pressure sensor circuit - Faulty the pressure sensor - Faulty installation of the pressure sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE E7EDE430

1. CHECK INSTALLATION OF PRESSURE SENSOR
Check if the pressure sensor is properly installed on the master cylinder.
Is the installation proper ?

NO

- Reinstall the pressure sensor properly.

YES

- Check power to the pressure sensor

2. CHECK POWER TO THE PRESSURE SENSOR

Disconnect the pressure sensor connector, and measure the voltage between terminals 1 and 3 of the pressure sensor connector.

Specification : 4.8~5.2 V

Is the power voltage within the specification?

NO

▶ Check harness and connector between the HECU and the pressure sensor.

YES

▶ Check output voltage of pressure sensor

3. CHECK OUTPUT VOLTAGE OF PRESSURE SENSOR

Measure the output voltage between terminal 2 of the pressure sensor connector and the body ground.

Specification : 0.5~4.5V

Is the output voltage within the specification?

NO

▶ Check harness and connector of the pressure sensor. If there is no error on the harness and the connector, replace the pressure sensor and recheck.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1259 STEERING ANGLE SENSOR-ELECTRICAL

GENERAL DESCRIPTION EDB0EB44

Steering angle sensor is a plate between the photo-controller LED and the photo transistor. As the plate rotates with steering wheel rotation, an electrical signal will be generated depending on whether the LED light passes through the plate to the photo-transistor or not. The signal is the steering wheel operation angular velocity and used to detect the steering wheel turning direction.

DTC DESCRIPTION E873FFCD

This code will set when there is an open or short in the circuit of the steering angle sensor.

DTC DETECTING CONDITION EAB0A7CF

DTC No.	Detecting Condition	Possible Cause
C1259	1.When Vsas > 4.4 or Vsas < 1.1 or 2.3V < Vsas < 2.7V continue 1sec, 2.The Monitoring starts 1 sec after Power Up.	- Faulty steering angle sensor - Faulty installation of steering angle sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EF8AA4DA

1. CHECK INSTALLATION OF STEERING ANGLE SENSOR

Check if the steering angle sensor is properly installed.
Is the installation proper?

NO

► Reinstall the steering angle sensor properly.

YES

► Check power of steering angle sensor

2. CHECK POWER TO THE STEERING ANGLE SENSOR

Disconnect the steering angle sensor connector, and measure the voltage between terminals 2 and 3 of the steering angle sensor connector.

Specification : 9~16 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the steering angle sensor.

YES

▶ Check output voltage of steering angle sensor

3. CHECK OUTPUT VOLTAGE OF STEERING ANGLE SENSOR

Measure the voltage between terminal 1,4, and 5 of the steering angle sensor connector and the body ground.

Specification : High : 3.0~4.1V

Low : 1.3~2.0V

Is the voltage within the specification?

NO

▶ Check harness and connector of the steering angle sensor. If there is no error on the harness and the connector, replace the steering angle sensor and recheck.

YES

▶ Check output of HECU connector

4. CHECK OUTPUT OF HECU CONNECTOR

Measure the voltage between terminal 8,40, and 39 of the HECU connector and the body ground.

Specification : High : 3.0~4.1V

Low : 1.3~2.0V

Is the voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the steering angle sensor.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1260 STEERING ANGLE SNSR-SIGNAL

GENERAL DESCRIPTION E1F2E97E

Steering angle sensor is a plate between the photo-controller LED and the photo transistor. As the plate rotates with steering wheel rotation, electrical signal will be generated depending on whether the LED light passes through the plate to the photo-transistor or not. The signal is the steering wheel operation angular velocity and used to detect the steering wheel turning direction.

DTC DESCRIPTION EDDBD63

This code shows in case that there is an irregular or no signal of the steering angle sensor.

DTC DETECTING CONDITION E335CEE

DTC No.	Detecting Condition	Possible Cause
C1260	[Offset error, stick] - The STN is low more than ± 20 degrees for 70msec. - When the steering wheel is turned more than 370 ± 5 degrees, If center is not detected , ECU detects the failure. - When the steering wheel angle is larger than 700 degrees ECU detects the failure. - During straight driving, If the steering wheel angle is larger than 55 ± 5 degree ECU detects the failure. - When the curve is detected after driving straight, If there is no variation of the steering wheel angle for 3sec, ECU detect the failure. - While the vehicle drive 60 ± 5 degrees $\leftrightarrow$ - 60 ± 5 degrees, If STN is not detected low, ECU detects the failure. - While steering angle sensor wheel through center, If steering angle sensor is against specification three times, ECU detect the failure. - When ther curve is detected after driving straight, if estimated value and measured value of the sensor indicate in the opposite direction for 2 times.	- Open/short in circuit of steering angle sensor - Faulty steering angle sensor - Faulty installation of steering angle sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE EE69E4EF

1. CHECK INSTALLATION OF STEERING ANGLE SENSOR
Check if the steering angle sensor is properly installed.
Is the installation proper?

NO

- Reinstall the steering angle sensor properly.

YES

- Check power of steering angle sensor

2. CHECK POWER OF STEERING ANGLE SENSOR

Disconnect the steering angle sensor connector, and measure the voltage between terminal 2 and 3 of the steering angle sensor connector.

Specification : 9~16 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the steering angle sensor.

YES

▶ Check output signal of steering angle sensor

3. CHECK OUTPUT SIGNAL OF STEERING ANGLE SENSOR

1) Check if both ST1 and ST2 alternate High and Low signal, rotating the wheel.

2) Check if STN has Low signal, rotating the wheel at 360 degree in one direction.
Is the signal of the steering angle sensor normal?

NO

▶ Check harness and connector of the steering angle sensor. If no error on the harness and the connector, replace the steering angle sensor and recheck.

YES

▶ After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1282 YAW RATE & LATERAL G SENSOR-ELECTRICAL

GENERAL DESCRIPTION E351A6EC

The yaw-rate & Lateral G sensor are used for the stability of a vehicle. The yaw-rate is used to measure angular velocity while the Lateral G is to measure the force that moves the vehicle away from the center, when a vehicle is cornering.

DTC DESCRIPTION E87EAFFC

This code sets when there is an open or short in the circuit of the yaw-rate & lateral G sensor.

DTC DETECTING CONDITION E1ACB797

DTC No.	Detecting Condition	Possible Cause
C1282	[Lateral G sensor open, short to GND] - When $V_{lg} > 4.90 \pm 0.05V$ or $V_{lg} < 0.10 \pm 0.05V$ continue 1sec, - The monitoring starts 1sec after power up. [YAW rate sensor open, short to GND] - When $V_{yaw} > 4.90 \pm 0.05V$ or $V_{yaw} < 0.10 \pm 0.05V$ continue 1sec, - The monitoring starts 1sec after power up. [CBIT / self test] - When CBIT is high ($> 3.6 V$), YAW signal voltage don't increase 0.1~1.2V than case of low state of CBIT pin. - Lateral G signal voltage is smaller than $4.1 \pm 0.1V$ when CBIT is high ($> 3.6 V$). - When GND of yaw rate sensor and lateral G sensor are open.	- Yaw Rate & Lateral G Sensor Open, short to GND - Faulty Yaw Rate & Lateral G Sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE E5CE5406

1. CHECK POWER OF YAW-RATE & LATERAL G SENSOR
Disconnect the connector from the yaw-rate& Lateral G sensor, and measure the voltage between terminals 3 and 4 of the yaw-rate& Lateral G sensor.

Specification : 4.75~5.25 V

Is the voltage within the specification?

NO

► Check harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

► Check output of yaw-rate & lateral G sensor

2. CHECK OUTPUT OF YAW-RATE & LATERAL G SENSOR

- 1) When the ignition switch is OFF, measure the voltage between terminal 1 of the yaw-rate sensor connector and the body ground.
- 2) When the ignition switch is OFF, measure the voltage between terminal 2 of the lateral G sensor connector and the body ground.

Specification : 2.25~2.75V

Is the voltage within the specification?

NO

► Check harness and connector of the yaw-rate & lateral G sensor. If no error on harness and connector, replace and recheck the yaw-rate & lateral G sensor.

YES

► Check output voltage of HECU connector for yaw-rate & lateral G sensor

3. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR FOR YAW-RATE & LATERAL G SENSOR

- 1) When the ignition switch is OFF, measure the output voltage between terminal 41 of the HECU connector and the ground.
- 2) When the ignition switch is OFF, measure the output voltage between terminal 9 of the HECU connector and the ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

► Repair harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

► After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1283 YAW RATE & LATERAL G SENSOR-SIGNAL

GENERAL DESCRIPTION E97C2574

The yaw-rate & Lateral G sensor are used for the stability of a vehicle. The yaw-rate is used to measure angular velocity while the Lateral G is used to measure the force that moves the vehicle away from the center, when a vehicle is cornering.

DTC DESCRIPTION E6557F1A

This code shows in case that there is an irregular or no signal of the yaw-rate & lateral G sensor.

DTC DETECTING CONDITION EC2FDDBE

DTC No.	Detecting Condition	Possible Cause
C1283	[Lateral G sensor noisy signal, offset error, stick] - During standstill if lateral G value is larger than 0.7g and continue 2sec, The failure is recognized - If noise of input signal is happened 429times in 5sec , Which the amplitude of the sensor signal is larger than predefined value(standstill : 0.3g , driving:0.5g~ 1.0g), The failure is recognized. The difference between estimated value and measured value of the sensor is larger than 0.3g~, The failure is recognized. - When the difference between estimated value and measured value of the sensor is lager than 0.3 g~(it's value change according to vehicle dynamic state), the difference value add and subtract. When sum Total value is larger than predefined value, The failure is recognized - When GND of yaw rate sensor and lateral G sensor are open. [YAW rate sensor noisy signal, offset error, stick] - During standstill if yaw rate value is larger than 7deg/s, And continue 2sec, The failure is recognized - If noise of input signal is happened 429times in 5sec , Which the amplitude of the sensor signal is larger than predefined value(standstill : 8deg/s , driving:15deg/s~ 30deg/s), The failure is recognized. - When the difference between estimated value and measured value of the sensor is lager than 7deg/s~(it's value change according to vehicle dynamic state), the difference value add and subtract. When sum Total value is larger than predefined value, The failure is recognized. - GND of yaw rate sensor and lateral G sensor are open.	- Yaw Rate & Lateral G Sensor Open, short to GND - Faulty Yaw Rate & Lateral G Sensor - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE

1. CHECK POWER OF YAW-RATE & LATERAL G SENSOR

Disconnect the connector from the yaw-rate & Lateral G sensor, and measure the voltage between terminal 3 and 4 of the yaw-rate & Lateral G sensor.

Specification : 4.75~5.25 V

Is the voltage within the specification?

NO

▶ Check harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ Check output of yaw-rate & lateral G sensor

2. CHECK OUTPUT OF YAW-RATE & LATERAL G SENSOR

- 1) When the ignition switch is OFF, measure the output voltage between terminal 1 of the yaw-rate sensor connector and the body ground.
- 2) When the ignition switch is OFF, measure the output voltage between terminal 2 of the lateral G sensor connector and the body ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

▶ Check harness and connector of the yaw-rate & lateral G sensor. If there is no error on harness and connector, replace and recheck the yaw-rate & lateral G sensor.

YES

▶ Check output voltage of HECU connector for yaw-rate & lateral G sensor

3. CHECK OUTPUT VOLTAGE OF HECU CONNECTOR FOR YAW-RATE & LATERAL G SENSOR

- 1) When the ignition switch is OFF, measure the output voltage between terminal 41 of the HECU connector and the body ground.
- 2) When the ignition switch is OFF, measure the output voltage between terminal 9 of the HECU connector and the body ground.

Specification : 2.25~2.75V

Is the output voltage within the specification?

NO

▶ Repair harness and connector between the HECU and the yaw-rate & lateral G sensor.

YES

▶ Check output of yaw-rate & lateral G sensor when vehicle cornering

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -135

4. CHECK OUTPUT OF YAW-RATE & LATERAL G SENSOR WHEN VEHICLE CORNERING.
Check if any change of the voltage of the yaw-rate & lateral G sensor, when the vehicle is cornering.
Is there any change of the voltage of the sensor?

NO

- Replace and recheck the yaw-rate & lateral G sensor.

YES

- After clearing the DTC and driving the vehicle at 40Km/h speed or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

DTC C1513 BRAKE LIGHT SWITCH MAL.

GENERAL DESCRIPTION E8DC44C6

The brake lamp switch is a normal-open(NO) type, and the brake switch is a normal-close(NC) type.

DTC DESCRIPTION EFD01941

This code will set when there is an open or short in the circuit of the brake switch, or if there is an error on the brake switch.

DTC DETECTING CONDITION E2072EDD

DTC No.	Detecting Condition	Possible Cause
C1513	[Open, short to BATT/GND, switch trouble] - If both BLS and BS have a same state and MCP > 20bar for 500ms, The failure is recognized. - Outside an ABS/TCS/ESP control, and after normal operation of MCP, If the pressure sensor signal is higher than 20bar and BLS is low for 3sec, The failure is recognized. - If the BLS/BS changed more than 40 times and MCP > 20bar for 5sec, The failure is recognized. - While Vref > 10KPH, TPS > 5%, MCP < 7bar, if BLS is high over 1 minute, The failure is recognized.	- Brake switch Open, short to GND - Faulty brake switch - Faulty HECU

FAILSAFE FUNCTION

The ESP function is inhibited, while the ABS and EBD controls allowed.
The ESP warning lamp is ON, but the ABS and EBD warning lamps OFF.

INSPECTION PROCEDURE ED30545C

1. CHECK OPEN/SHORT IN CIRCUIT OF BRAKE SWITCH

- 1) Disconnect the connector from the HECU, and measure the voltage between terminal 21 of the HECU connector and the body ground, not pushing the brake pedal.

Specification : Battery (B+)

- 2) Disconnect the connector from the HECU, and measure the voltage between terminal 21 of the HECU connector and the body ground, pushing the brake pedal.

Specification : 0V

Is the voltage within the specification?

NO

- Repair harness and connector of the brake switch.

YES

- Check open/short in circuit of brake lamp switch

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -137

2. CHECK OPEN/SHORT IN CIRCUIT OF BRAKE LAMP SWITCH

- 1) Disconnect the connector from the HECU, and measure the voltage between terminal 18(ESP:5) of the HECU connector and the body ground, not pushing the brake pedal.

Specification : 0V

- 2) Disconnect the connector from the HECU, and measure the voltage between terminal 18(ESP:5) of the HECU connector and the body ground, pushing the brake pedal.

Specification : Battery (B+)

Is the voltage within the specification?

NO

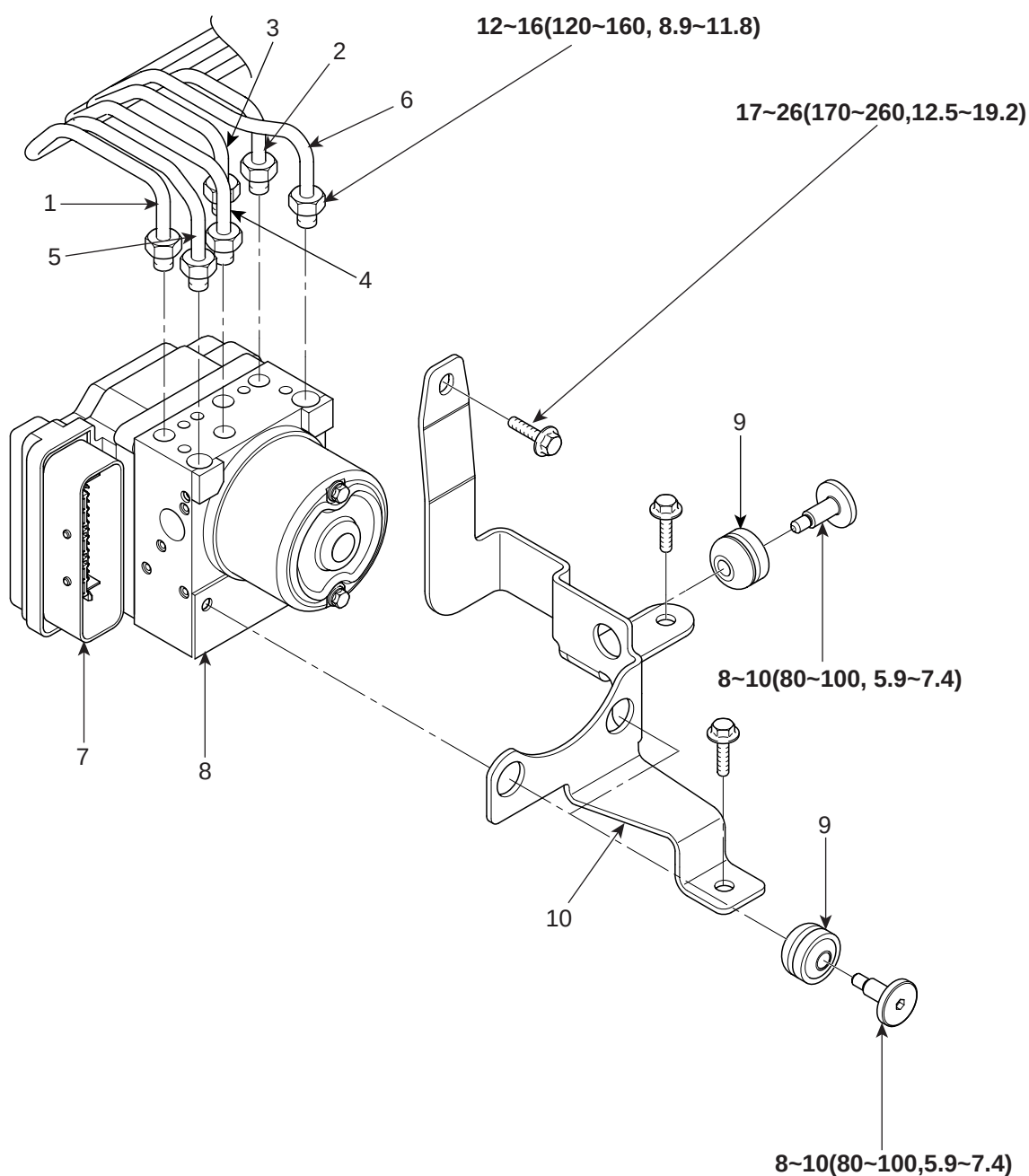
- ▶ Repair harness and connector of the brake lamp switch.

YES

- ▶ After clearing the DTC and driving the vehicle at 40Km/h or more, if the ESP lamp is ON and the same DTC shows again, replace the HECU and recheck.

ANTI-LOCK BRAKING SYSTEM CONTROL MODULE

COMPONENTS E24C4F29



TORQUE : Nm(Kgf·cm,lbf·ft)

1. Front-left tube
2. Front-right tube
3. Rear-left tube
4. Rear-right tube
5. Master cylinder Secondary(MCS) tube

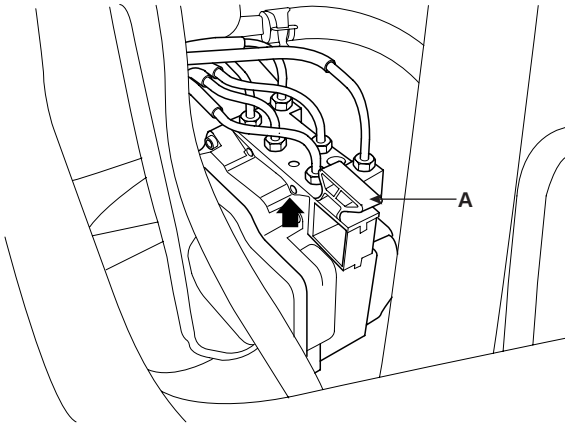
6. Master cylinder Primary(MCP) tube
7. ABS control module connector(25P)
8. ABS control module(HECU)
9. Damper
10. Bracket

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -139

REMOVAL EECDE11A

1. Disconnect the double lock (A) from the HECU.



ARJE503S

2. Disconnect the brake tube from the HECU by unlocking the nuts centerclockwise with a spanner.

NOTE

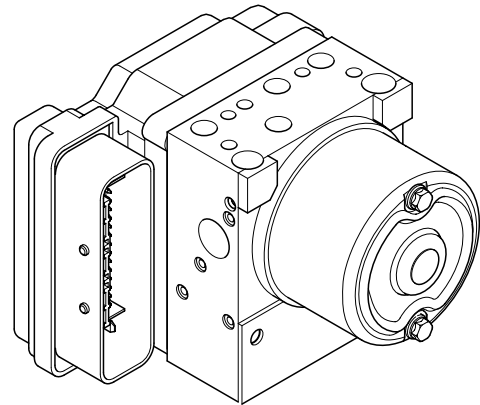
- Do not spill brake fluid on vehicle; it may damage the paint; if brake fluid gets on the paint, wash it off immediately with water.
- Take care not to damage or deform the brake lines during removal and installation.
- To prevent the brake fluid from spilling, plug and cover the hose ends and joints with a shop towel or equivalent material.

3. Remove the three HECU brake mounting bolts disassembly the HECU with the bracket.



CAUTION

1. Never attempt to disassemble the HECU.
2. The HECU must be transported and stored in an upright position and with the ports sealed.



ARJE009B

4. Remove the three HECU mounting bolts and remove the HECU from the bracket.

INSTALLATION E55C443E

1. Installation is the reverse of removal.
2. Tighten the HECU mounting bolts and brake tube nuts to the specified torque.

Tightening torque

HECU mounting bolt:

8~10Nm (80~100 kg·cm, 5.9~7.3 lbf·ft)

HECU bracket mounting bolt:

17~26 Nm (170~260 kg·cm, 12.5~19.1 lbf·ft)

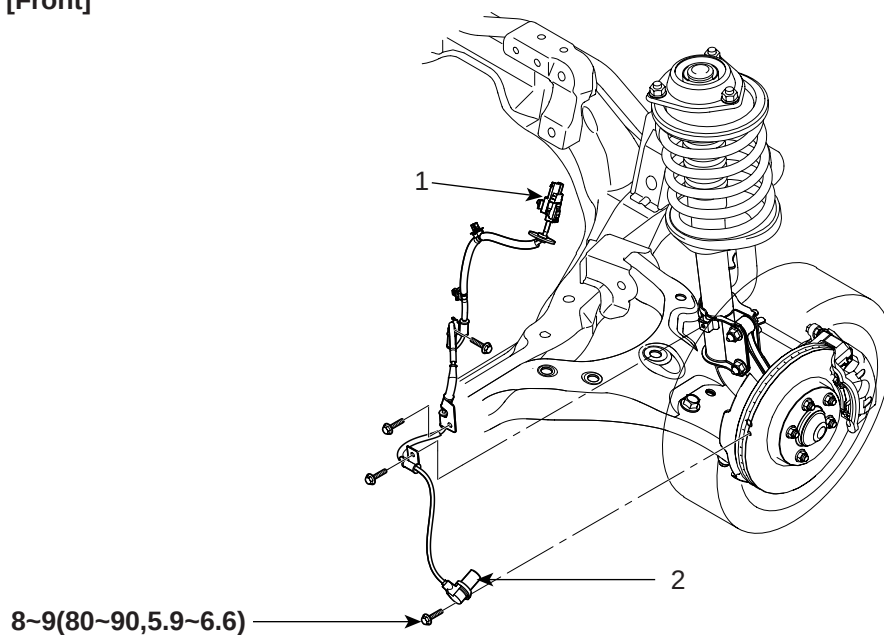
Brake tube nut:

13~17 Nm (130~170 kg·cm, 9.5~12.5 lbf·ft)

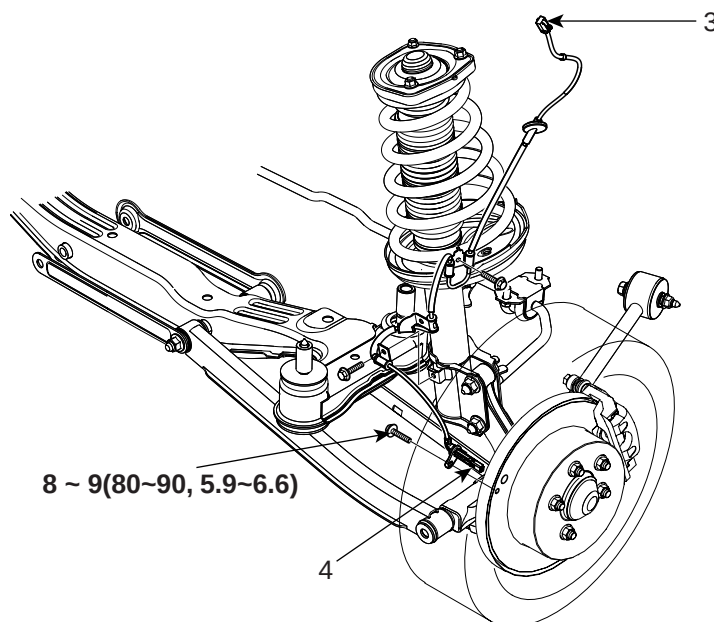
ANTI-LOCK BRAKING SYSTEM WHEEL SPEED SENSOR

COMPONENTS E16E25AE

[Front]



[Rear]



TORQUE : Nm(kgf·cm, lbf·ft)

- 1. Front wheel speed sensor connector
- 2. Front wheel speed sensor

- 3. Rear wheel speed sensor connector
- 4. Rear wheel speed sensor

ABS (ANTI-LOCK BRAKE SYSTEM)

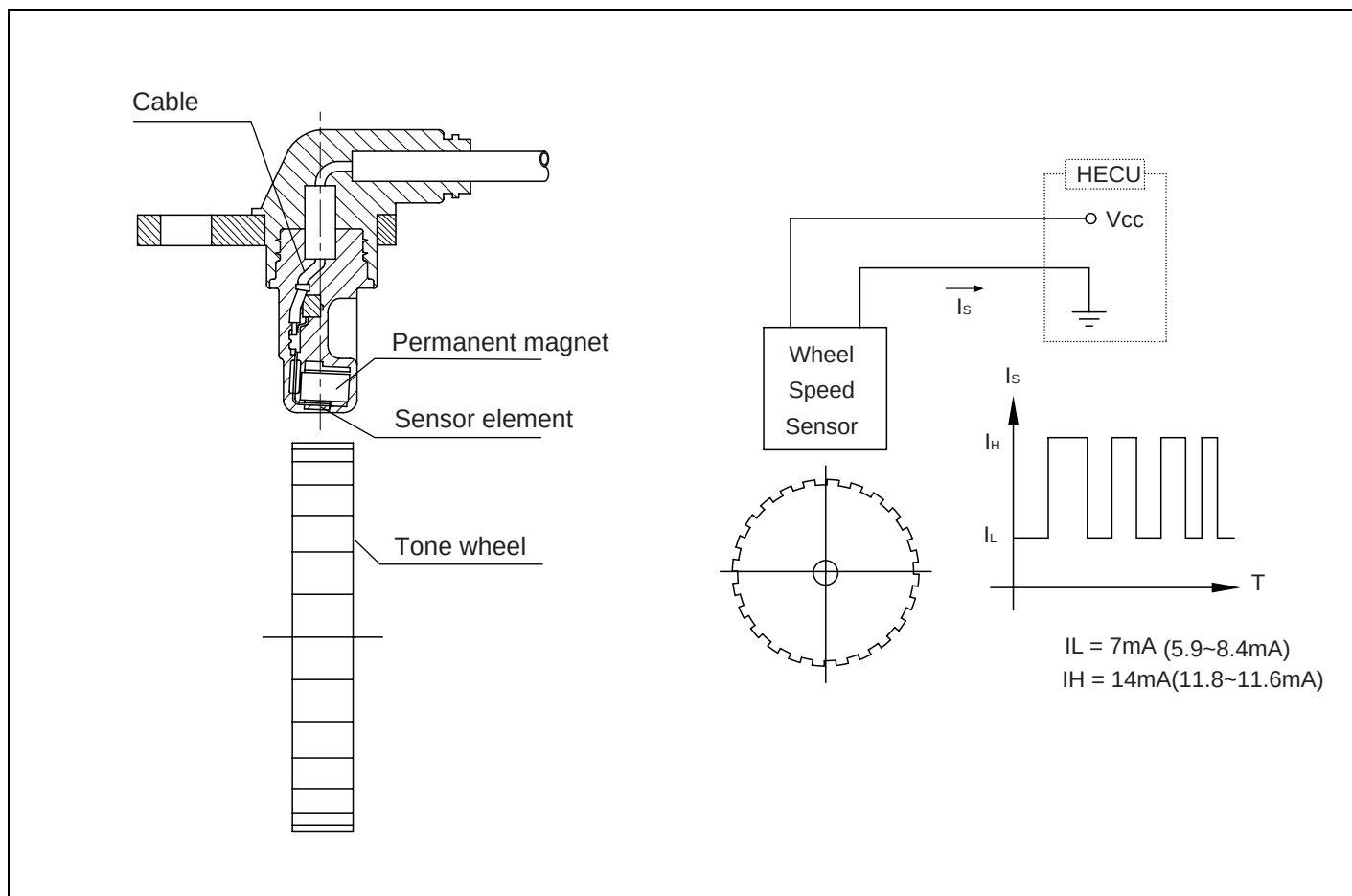
BR -141

DESCRIPTION E5B6D3D5

A toothed rotor is fixed to the rotating member of the wheel, and the sensor is fixed to the static member of the suspension. As the wheel rotates the toothed rotor causes magnetic flux changes in the magnetic field of the permanent magnet. The sensor element senses these changes.

Depending on the flux changes the sensor sends a signal out to the ECU. The change in magnet flux thus the sensor signal is directly related to the wheel speed.

The controller monitors the sensor signal, compares the four wheel-speed signals and initiates action as required.



EJQE206D

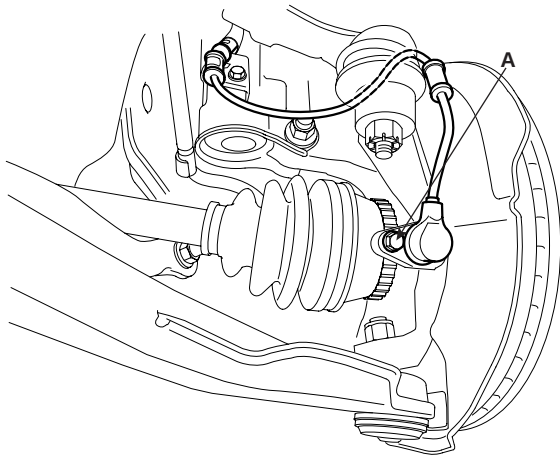
SPECIFICATIONS

Item	Standard Value		Remark
Supply voltage	DC 12V		
Operating temperature	-40~120°C		R=100Ω
Output current range	Low	7mA(5.9~8.4mA)	
	High	14mA(11.8~16.8mA)	
Frequency range	1~2000 Hz		
Airgap	0.5~1.5mm(0.0197~0.0591 in.)		
Tone wheel	Number	48	

REMOVAL EBF555E3

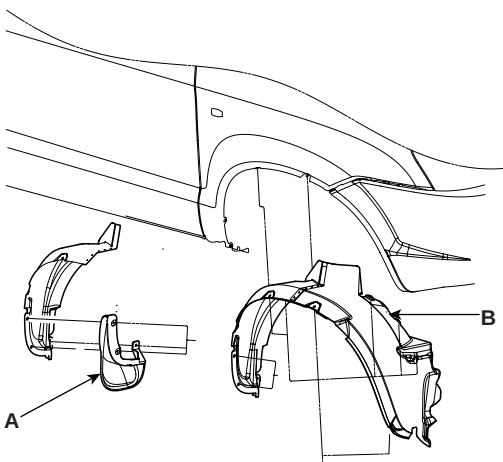
FRONT WHEEL SPEED SENSOR

1. Remove the front wheel speed sensor mounting bolt (A).



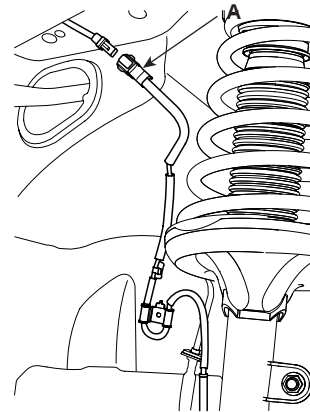
KJKD220A

2. Remove the front wheel guard (B), after removing the mud guard (A).



KJQE160C

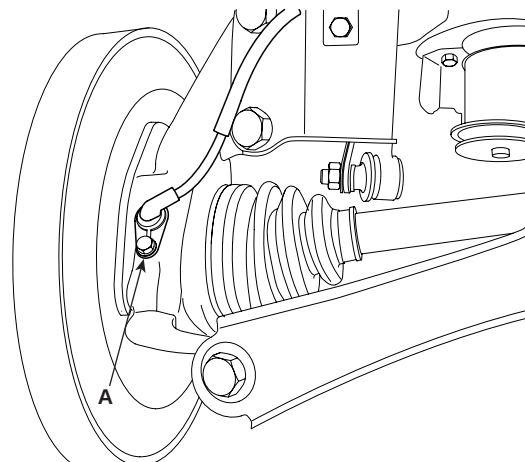
3. Remove the front wheel speed sensor after disconnecting the wheel speed sensor connector (A).



KJQE710A

REAR WHEEL SPEED SENSOR

1. Remove the rear wheel speed sensor mounting bolt (A).

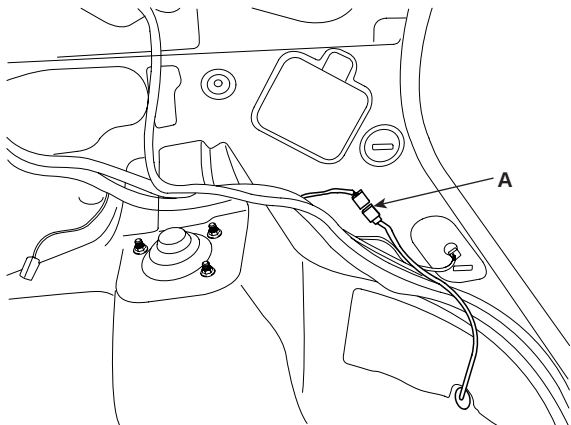


KJQE710B

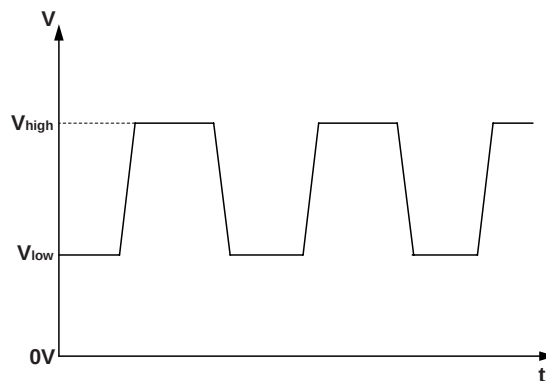
ABS (ANTI-LOCK BRAKE SYSTEM)

BR -143

2. Remove the rear seat side pad then disconnect the rear wheel speed sensor connector (A).
2. Compare the change of the output voltage of the wheel speed sensor to the normal change of the output voltage as shown below.



KJQE710C



KJQE260B

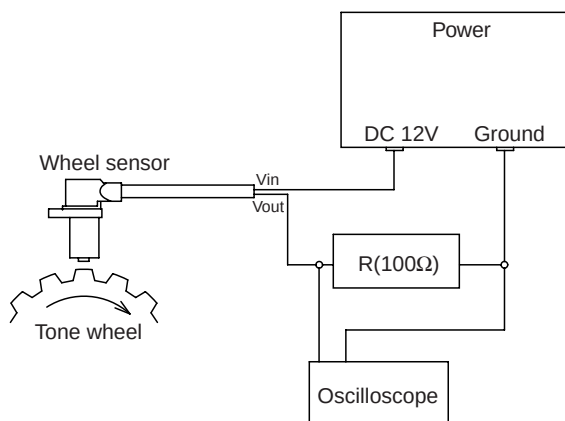
INSPECTION EF51AFED

1. Measure the output voltage between the terminal of the wheel speed sensor and the body ground.



CAUTION

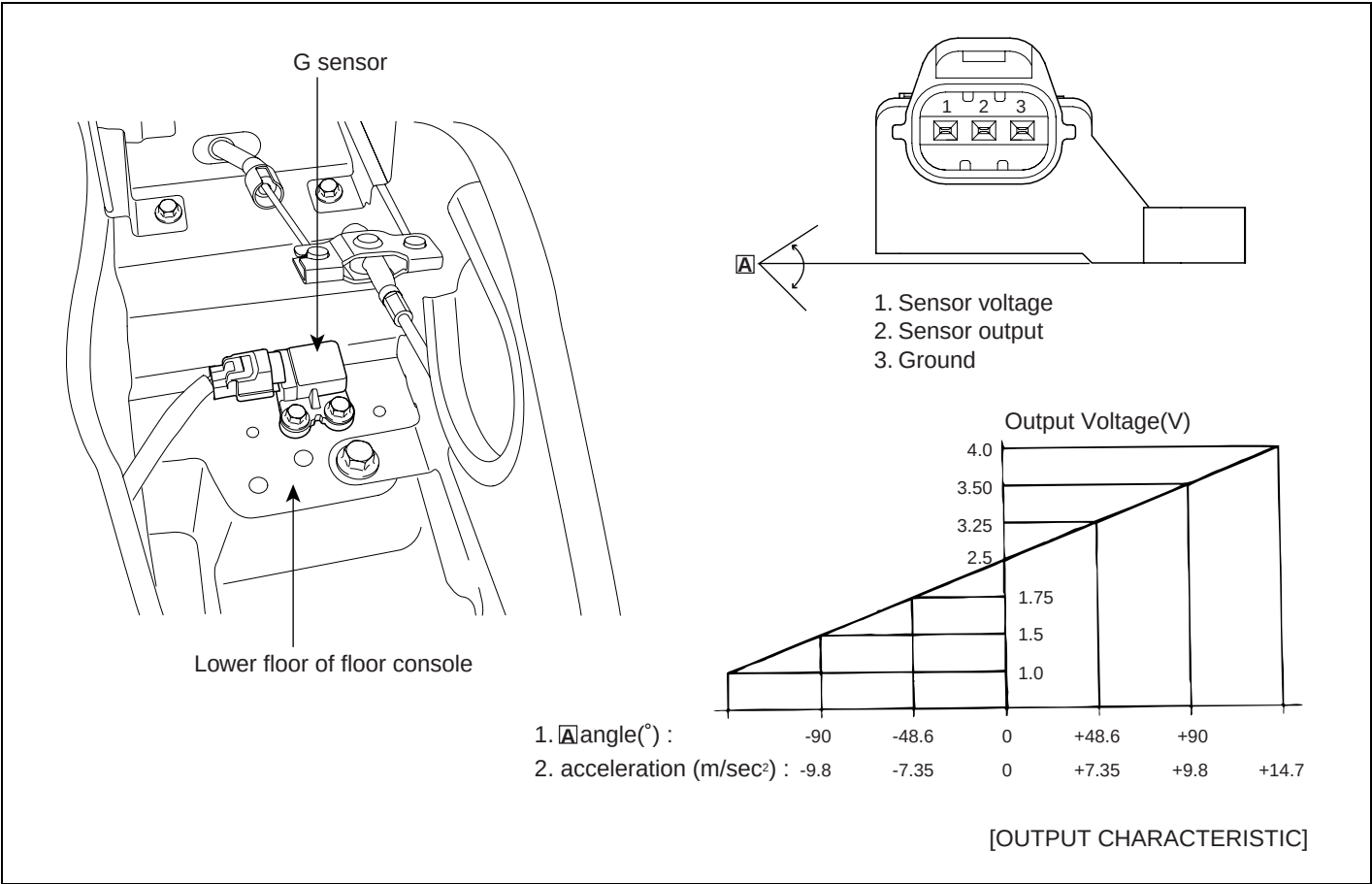
In order to protect the wheel speed sensor, when measuring output voltage, a 100Ω resistor must be used as shown.



EJQE260A

G SENSOR

COMPONENTS ED0727A3



EJQE820A

ABS (ANTI-LOCK BRAKE SYSTEM)

BR -145

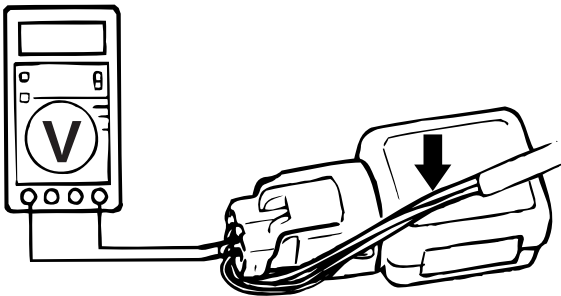
INSPECTION

EB974FA1

1. Connect a tester to both 2 and 3 terminals of the G sensor.
2. Measure the output voltage when IGN is on.

Specification : 2.5V

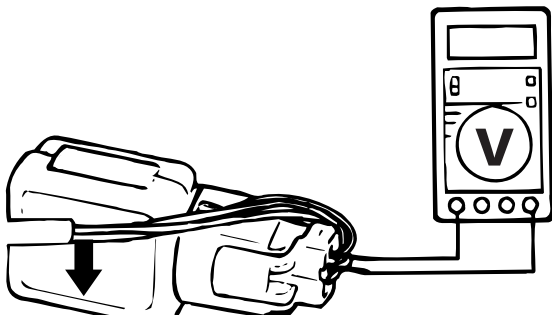
4. Replace the G sensor if the output voltage is not on the specification.



KJQE820D

3. Measure the output voltage between 2 and 3 terminals, posing the arrow mark on the G sensor downward.

Specification : 3.5V



KJQE820C

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION)

EBD (ELECTRONIC BRAKE-FORCE DISTRIBUTION) OPERATION EDEF93A0

The EBD system (Electronic Brake force Distribution) as a sub-system of the ABS system is to control the effective adhesion utilization by the rear wheels.

It further utilizes the efficiency of highly developed ABS equipment by controlling the slip of the rear wheels in the partial braking range.

The brake force is moved even closer to the optimum and controlled electronically, thus dispensing with the need for the proportioning valve.

The proportioning valve, because of a mechanical device, has limitations to achieve an ideal brake force distribution to the rear wheels as well as to carry out the flexible brake force distribution proportioning to the vehicle load or weight increasing. And in the event of malfunctioning, driver cannot notice whether it fails or not.

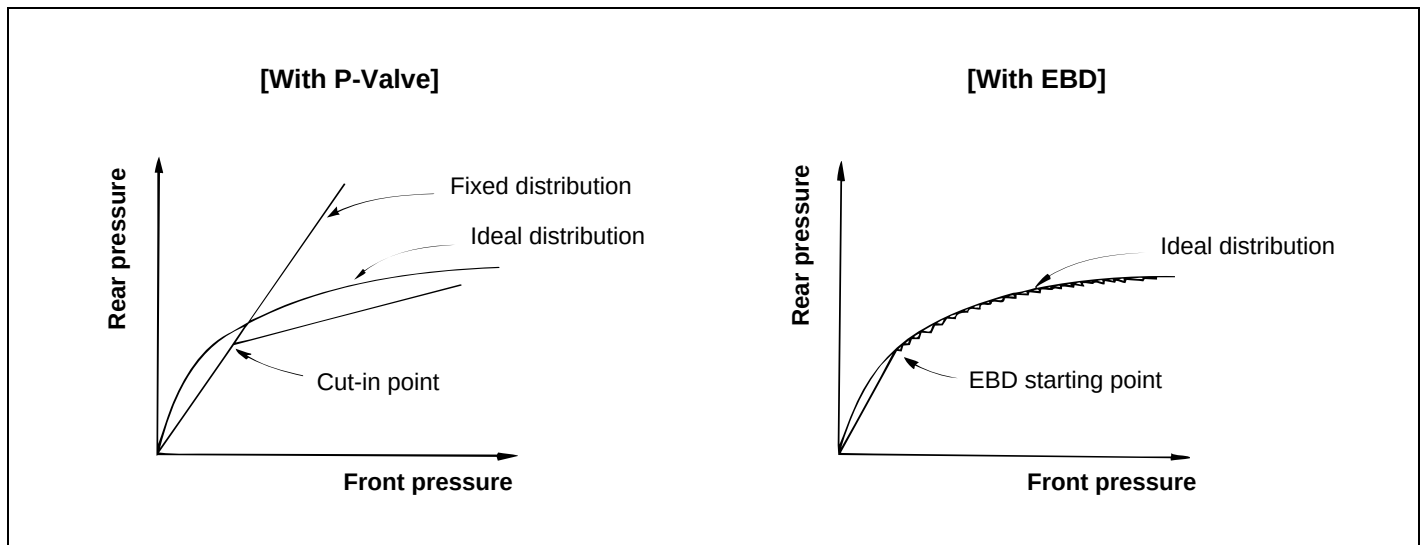
EBD controlled by the ABS Control Module, calculates the slip ratio of each wheel at all times and controls the brake pressure of the rear wheels not to exceed that of the front wheels.

If the EBD fails, the EBD warning lamp (Parking brake lamp) lights up.

ADVANTAGES

- Function improvement of the base-brake system.
- Compensation for the different friction coefficients.
- Elimination of the proportioning valve.
- Failure recognition by the warning lamp.

COMPARISON BETWEEN PROPORTIONING VALVE AND EBD



EJA0032A

ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

DESCRIPTION OF ESP EC947DC7

Optimum driving safety now has a name : ESP, the Electronic Stability Program.

ESP is based on the MGH 25 ABS Hydraulic System. ESP recognizes critical driving conditions, such as panic reactions in dangerous situations, and stabilizes the vehicle by wheel-individual braking and engine control intervention with no need for actuating the brake or the gas pedal.

ESP adds a further function known as Active Yaw Control (AYC) to the ABS, TCS, EBD and EDC functions. Whereas the ABS/TCS function controls wheel slip during braking and acceleration and, thus, mainly intervenes in the longitudinal dynamics of the vehicle, active yaw control stabilizes the vehicle about its vertical axis.

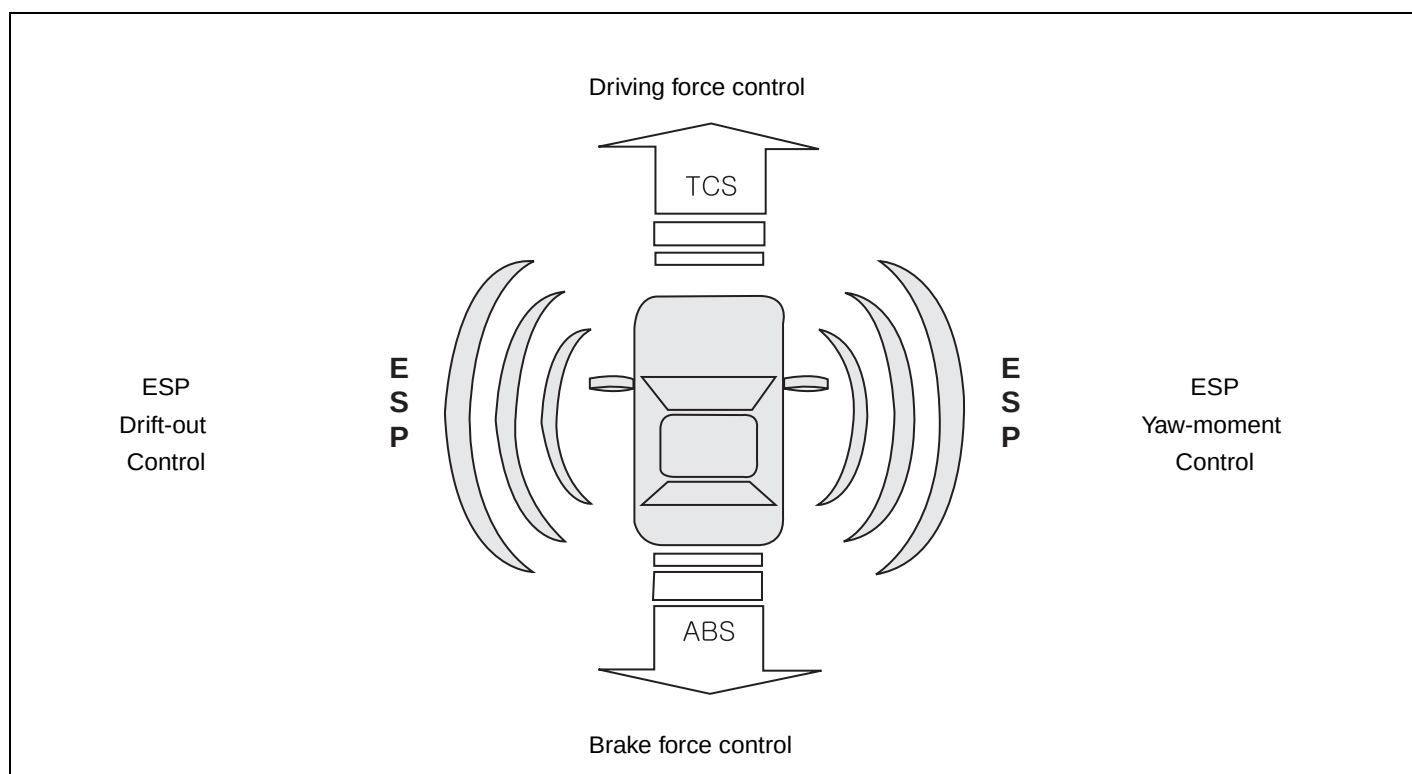
This is achieved by wheel individual brake intervention and adaptation of the momentary engine torque with no need for any action to be taken by the driver.

ESP essentially consists of three assemblies : the sensors, the electronic control unit and the actuators.

The electronic control unit incorporates the technological experience accumulated in connection with the MK 20 system, but has been substantially expanded in terms of capacity and monitoring concept in order to permit the additional sensor signals and arithmetic operations to be processed and converted into corresponding valve, pump and engine control commands. Two 16-bit processors and one 8-bit processor, which monitor each other, cooperate to handle these requirements.

Of course, the stability control feature works under all driving and operating conditions. Under certain driving conditions, the ABS/TCS function can be activated simultaneously with the ESP function in response to a command by the driver.

In the event of a failure of the stability control function, the basic safety function, ABS, is still maintained.



LJCD201A

DESCRIPTION OF ESP CONTROL

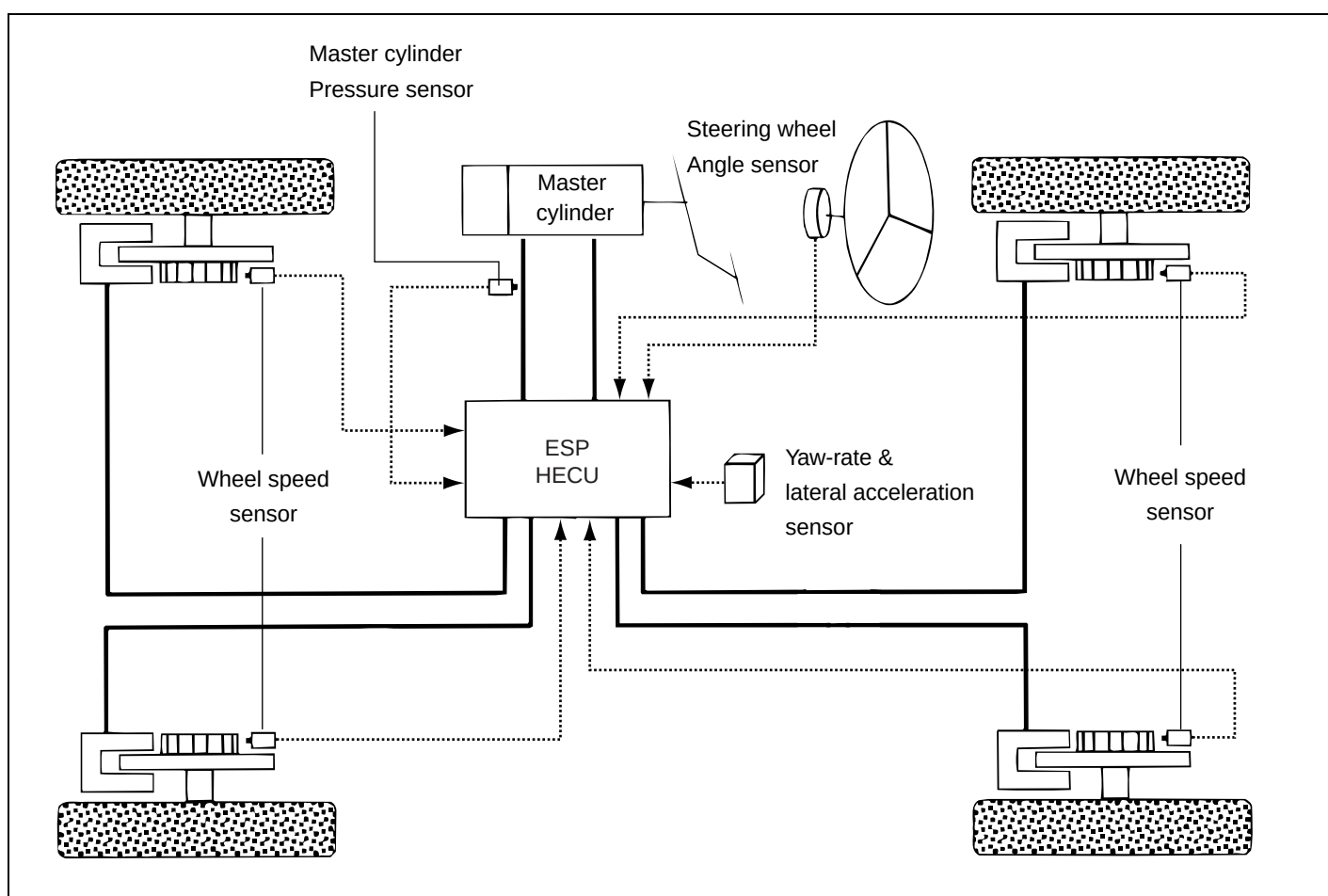
ESP system includes ABS/EBD, TCS and AYC function.

ABS/EBD function The ECU changes the active sensor signal (current shift) coming from the four wheel sensors to the square wave. By using the input of above signals, the ECU calculates the vehicle speed and the acceleration & deceleration of the four wheels. And, the ECU judges whether the ABS/EBD should be actuated or not.

TCS function prevents the wheel slip of drive direction by adding the brake pressure and engine torque reduction via CAN communication. TCS function uses the wheel speed sensor signal to determine the wheel slip as far as ABS function.

AYC function prevents unstable maneuver of the vehicle. To determine the vehicle maneuver, AYC function uses the maneuver sensor signals (Yaw Rate Sensor, Lateral Acceleration Sensor, Steering Wheel Angle Sensor). If vehicle maneuver is unstable (Over Steer or Under Steer), AYC function applies the brake pressure on certain wheel, and send engine torque reduction signal by CAN.

After the key-on, the ECU continually diagnoses the system failure. (self-diagnosis) If the system failure is detected, the ECU informs driver of the system failure through the BRAKE/ABS/ESP warning lamp. (fail-safe warning)



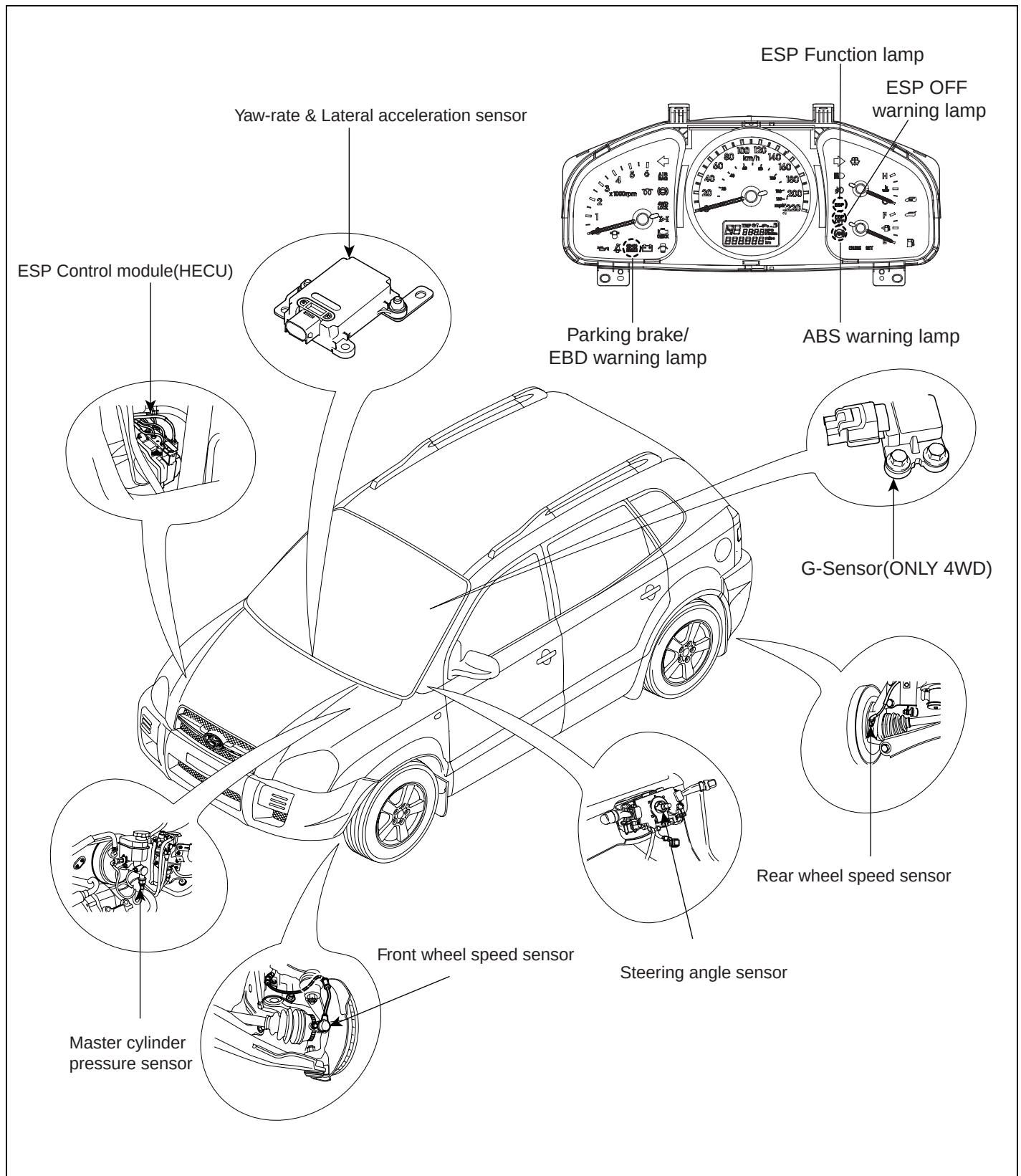
EJQE005M

ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

BR -149

COMPONENTS

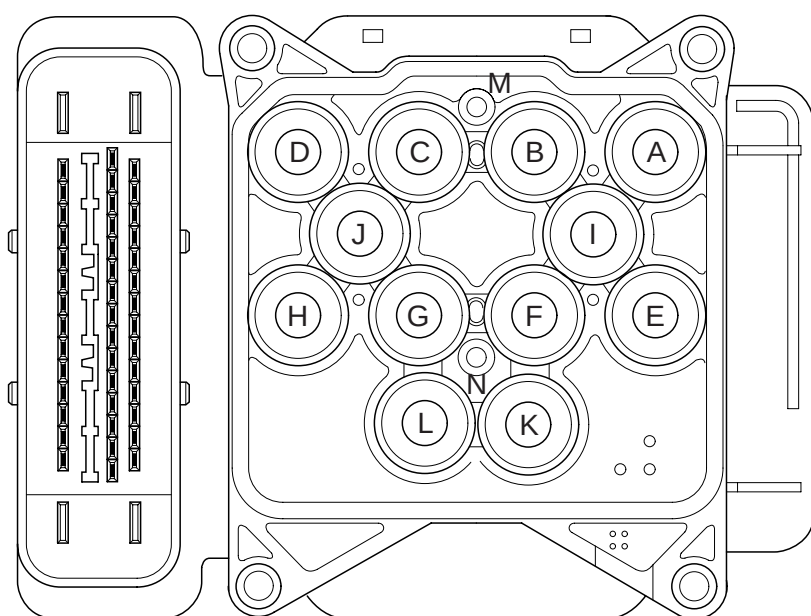
E2CE0CA4



LJIF501N

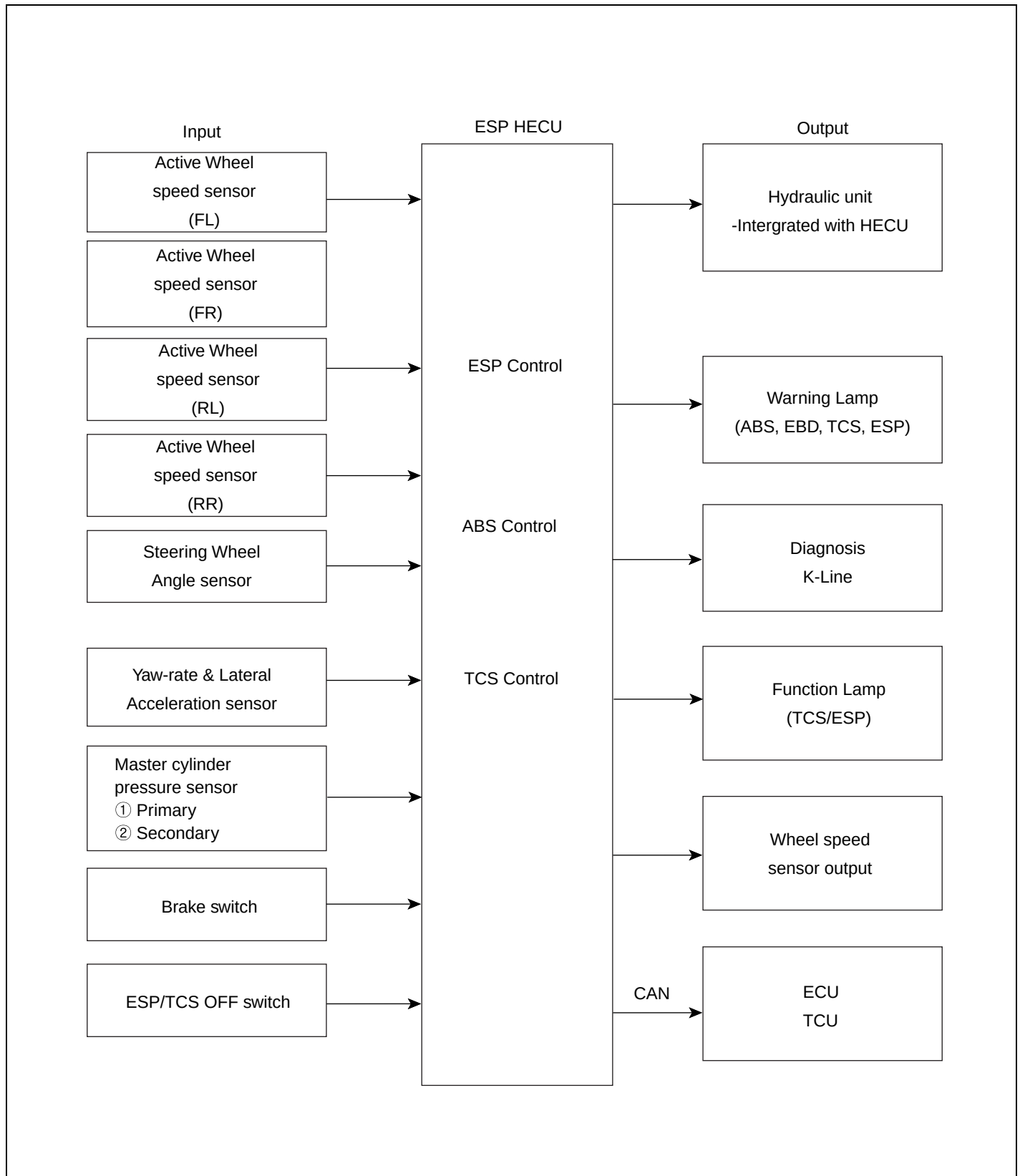
ESP HECU EXTERNAL DIAGRAM

EC1BC97E



- A : INLET VALVE(FR)
- B : INLET VALVE(RL)
- C : INLET VALVE(RR)
- D : INLET VALVE(FL)
- E : OUTPUT VALVE(FR)
- F : OUTPUT VALVE(RL)
- G : OUTPUT VALVE(RR)
- H : OUTPUT VALVE(FL)
- I : ELECTRIC SHUTTLE VALVE(ESV-R)
- J : ELECTRIC SHUTTLE VALVE(ESV-L)
- K : TRACTION VALVE (TCR)
- L : TRACTION VALVE (TCL)
- M : MOTOR(+)
- N : MOTOR(GND)

INPUT AND OUTPUT DIAGRAM



EJQE901C

ESP OPERATION MODE

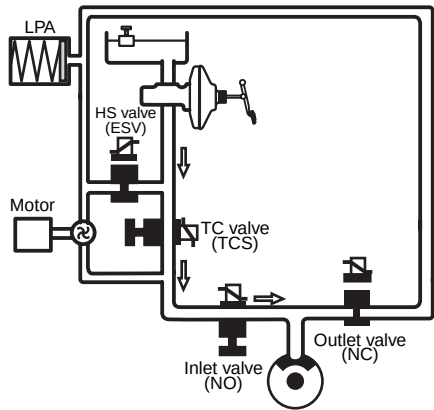
E04ECFD9

1. ESP Non-operation-Normal braking.

Operation

In this position, the inlet valve and the TCS valve are open, the electrically operated shuttle valve and the outlet valve are closed.

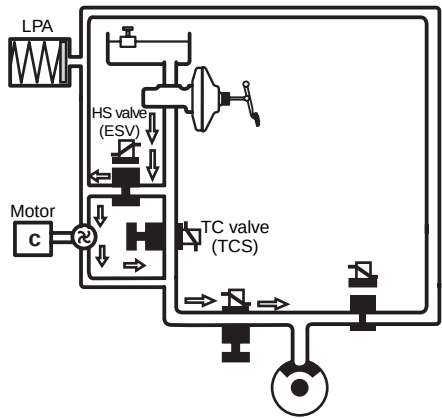
*ESV : Electric reversing valve.



LJCD207A

Solenoid valve	Continuity	Valve	Motor pump	TC Valve
IN (NO)	OFF	OPEN	OFF	OFF
OUT (NC)	OFF	CLOSE		

2. ESP operation

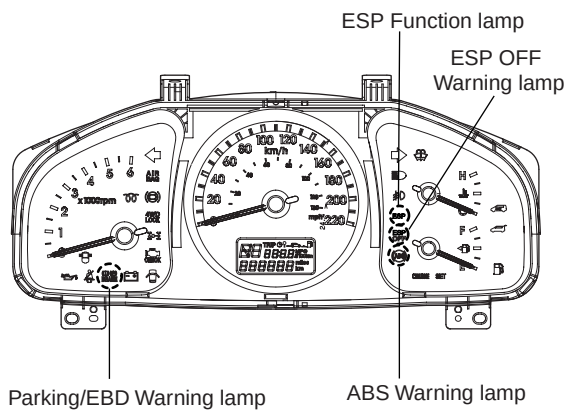


Operation

The on/off booster builds up a pressure of approx. 10 bar in order to enable the ESP pump to suck brake fluid at low temperatures. In this position, the inlet valve is driven in a pulsed cycle. The TCS valve is closed. The outlet valve remains closed. The electrically operated shuttle valve is opened. The hydraulic pressure is led to the wheel brakes which are to be applied for a brief period of time.

LJCD208A

Solenoid valve		Continuity	Valve	Motor pump	TC Valve
Understeering (Only inside of rear wheel)	IN(NO)	OFF	OPEN	ON	ON
	OUT(NC)	OFF	CLOSE		
Oversteering (Only outside of front wheel)	IN(NO)	OFF	OPEN		
	OUT(NC)	OFF	CLOSE		



LJIF5010

ABS WARNING LAMP MODULE

The active ABS warning lamp module indicates the self-test and failure status of the ABS. The ABS warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ABS functions by failure.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

EBD WARNING LAMP MODULE

The active EBD warning lamp module indicates the self-test and failure status of the EBD. However, in case the Parking Brake Switch is turned on, the EBD warning lamp is always turned on regardless of EBD functions. The EBD warning lamp shall be on:

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the Parking Brake Switch is ON or brake fluid level is low.
- When the EBD function is out of order.
- During diagnostic mode.
- When the ECU Connector is separated from ECU.

ESP WARNING LAMP (ESP SYSTEM)

The ESP warning lamp indicates the self-test and failure status of the ESP.

The ESP warning lamp is turned on under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- In the event of inhibition of ESP functions by failure.
- When driver turn off the ESP function by on/off switch.
- During diagnostic mode.

ESP FUNCTION LAMP (ESP SYSTEM)

The ESP function lamp indicates the self-test and operating status of the ESP.

The ESP Function lamp operates under the following conditions :

- During the initialization phase after IGN ON. (continuously 3 seconds).
- When the ESP control is operating. (Blinking - 2Hz)

ESP ON/OFF SWITCH (ESP SYSTEM)

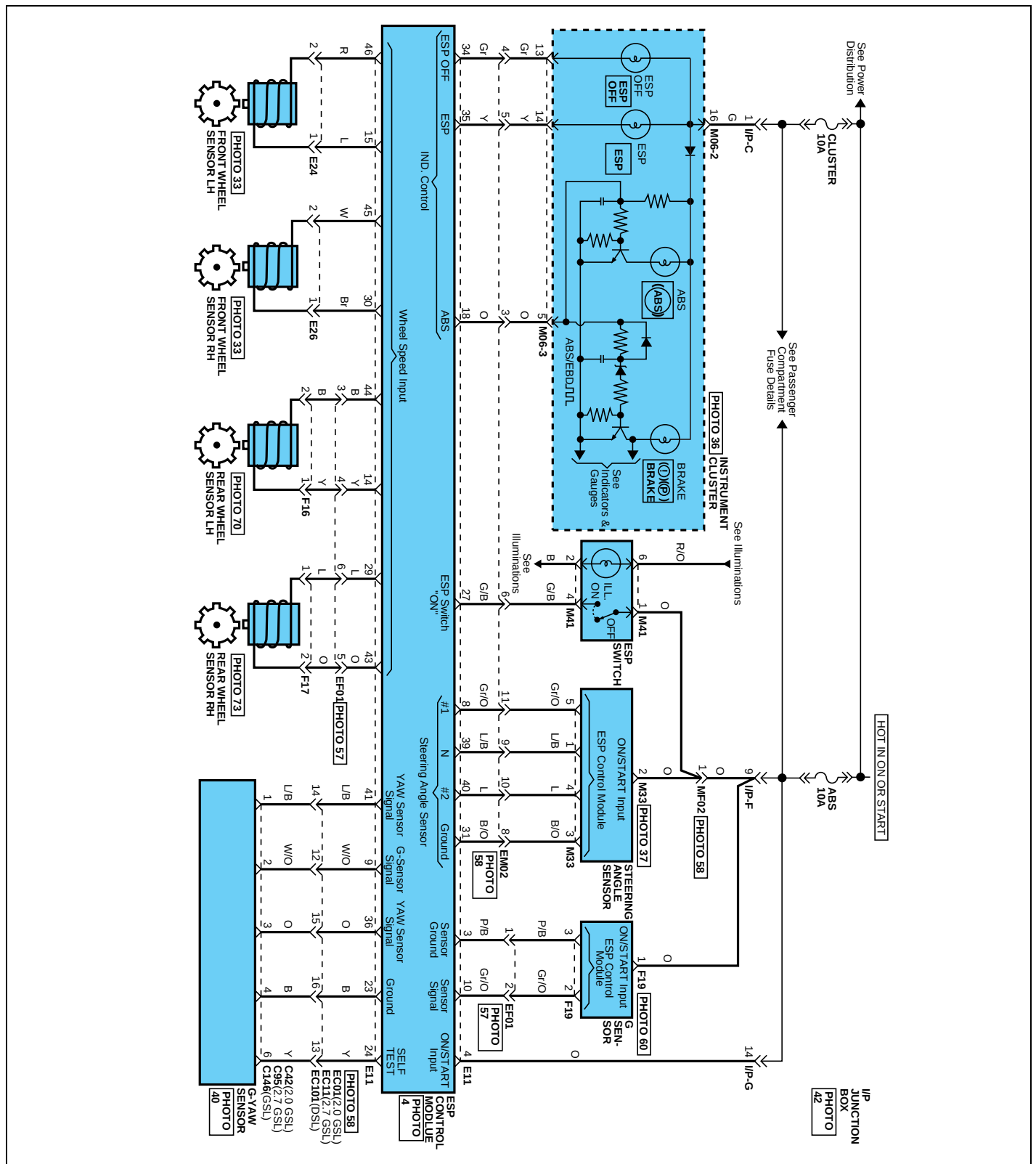
The ESP On/Off Switch shall be used to toggle the ESP function between On/Off states based upon driver input.

The On/Off switch shall be a normally open, momentary contact switch. Closed contacts switch the circuit to ignition.

Initial status of the ESP function is on and switch toggle the state.

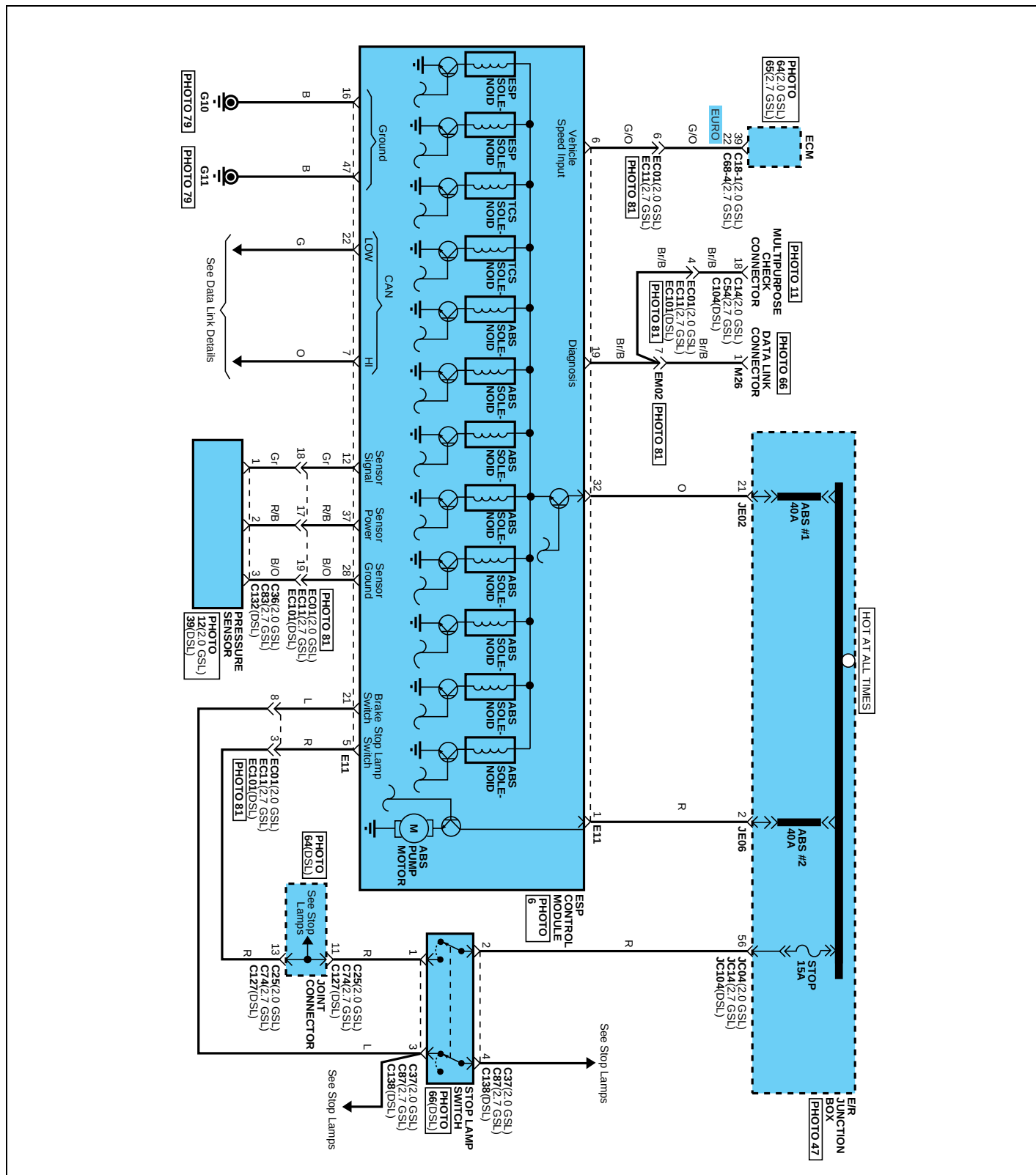
CIRCUIT DIAGRAM(1)-ESP

EEDB42F8



LJIF501P

CIRCUIT DIAGRAM(2)-ESP



LJIF501Q

ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

BR -157

ESP CONNECTOR INPUT/OUTPUT

Connector Terminal		Specification	Remark
No	Description		
4	IGNITION1(+)		
32	POS.BATTERY.(SOLENOID)	Max leakage current : $I < 0.8\text{mA}$	
1	POS.BATTERY.(MOTOR)	Operating voltage range: $9.5\pm0.5\text{V} < V < 16.5\pm0.5\text{V}$ Rush current : $I < 100\text{A}$ Max current : $I < 30\text{A}$ Max leakage current : $I < 0.2\text{mA}$	
16	GROUND	Rated current : $I < 300\text{mA}$ Max. current: $I < 30\text{A}$	
47	PUMP MOTOR GROUND	Rush current : $I < 100\text{A}$ Max current : $I < 30\text{A}$	
23	YAW & LATERAL G SENSOR GROUND	Rated current : $I < 65\text{mA}$	
28	MASTER PRESSURE SENSOR GROUND	Rated current : $I < 10\text{mA}$	
31	STEERING ANGLE SENSOR GROUND	Rated current : $I < 100\text{mA}$	
37	MASTER PRESSURE SENSOR POWER	Max Output current : $I < 10\text{mA}$ Max Output voltage : $4.9\text{V} \leq V \leq 5.1\text{V}$	
36	YAW SENSOR POWER	Max Output current : $I < 65\text{mA}$ Max Output voltage : $4.9\text{V} \leq V \leq 5.1\text{V}$	
5	BRAKE LIGHT SWITCH	Input voltage low: $0\text{V} \leq V \leq 3.0\text{V}$	
21	BRAKE SWITCH	Input voltage High: $7.0\text{V} \leq V \leq 16.0\text{V}$	
6	SENSOR FRONT RIGHT OUTPUT	Max current : $I < 2\text{mA}$ External pull up resistance : $10\text{K}\Omega < R$ Output duty : $50 \pm 20\%$	
18	ABS/EBD W/LAMP DRIVE	Max. current: $I < 200\text{mA}$ Max. output low voltage: $V < 1.2\text{V}$	
34	ESP W/LAMP DRIVE		
35	ESP F/LAMP DRIVE		
27	ESP ON/OFF SWITCH	Input voltage low: $0\text{V} \leq V \leq 3.0\text{V}$ Input voltage High: $7.0\text{V} \leq V \leq 16.0\text{V}$ Max input current: $I < 10\text{mA}$	
22	CAN BUS LINE(LOW)	Max. current : $I < 10\text{mA}$	
7	CAN BUS LINE(HIGH)		
46	SENSOR FRONT LEFT POWER	Output voltage : $\text{IGN}(V) \pm 1\text{V}$ Output current : Max 30mA	
45	SENSOR FRONT RIGHT POWER		
44	SENSOR REAR LEFT POWER		
43	SENSOR REAR RIGHT POWER		

15	SENSOR FRONT LEFT SIGNAL	Input current LOW : 5.9 ~8.4 mA Input current HIGH :11.8 ~ 16.8 mA Frequency range :1 ~ 2000 Hz Input duty : 50 ±20%	
30	SENSOR FRONT RIGHT SIGNAL		
14	SENSOR REAR LEFT SIGNAL		
29	SENSOR REAR RIGHT SIGNAL		
8	STEERING ANGLE SENSOR PHASE 1	Input duty (ST1, ST2): 50 ±10 Phase difference (ST1, ST2): 2 ± 0.6deg High voltage: 3.0V < V < 4.1V Low voltage: 1.3V < V < 2.0V	
40	STEERING ANGLE SENSOR PHASE 2		
39	STEERING ANGLE SENSOR PHASE N		
12	MASTER PRESSURE SENSOR SIGNAL	Sensor Input Voltage : 0V ≤ V ≤ 5.0V Zero offset Voltage : 0.5V ± 0.15V Input current :Max 2 mA	
9	LATERAL G SENSOR SIGNAL	Sensor Input Voltage :0V ≤ V ≤ 5.0V Zero offset Voltage : 2.5 ± 0.1V	
41	YAW SENSOR SIGNAL	Sensor Input Voltage :0V ≤ V ≤ 5.0V Zero offset Voltage : 2.5 ±0.1V	
10	G SENSOR SIGNAL Input Voltage	Input Voltage: 0≤ V≤ 5.0V	with 4WD
3	G SENSOR GROUND	Rated current: I < 10mA	
19	DIAGNOSIS INPUT/OUTPUT	Input voltage IL(V) < 0.3 IGN (V) IH(V) > 0.7 IGN (V) Output voltage OL(V) < 0.2 IGN (V) OH(V) > 0.8 IGN (V)	

FAILURE DIAGNOSIS

EFB0C2FA

1. In principle, ESP and TCS controls are prohibited in case of ABS failure.
2. When ESP or TCS fails, only the failed system control is prohibited.
3. However, when the solenoid valve relay should be turned off in case of ESP failure, refer to the ABS fail-safe.
4. Information on ABS fail-safe is identical to the fail-safe in systems where ESP is not installed.

MEMORY OF FAIL CODE

1. It keeps the code as far as the backup lamp power is connected. (O)
2. It keeps the code as far as the HCU power is on. (X)

FAILURE CHECKUP

1. Initial checkup is performed immediately after the HECU power on.
2. Valve relay checkup is performed immediately after the IG2 ON.
3. It executes the checkup all the time while the IG2 power is on.
4. Initial checkup is made in the following cases.
 - 1) When the failure is not detected now
 - 2) When ABS and ESP are not in control.
 - 3) Initial checkup is not made after ECU power on.
 - 4) If the vehicle speed is over 5 mph(8 km/h) when the brake lamp switch is off.
 - 5) When the vehicle speed is over 24.8 mph(40 km/h).
5. Though, it keeps on checkup even if the brake lamp switch is on.
6. When performing ABS or ESP control before the initial checkup, stop the initial checkup and wait for the HECU power input again.
7. Judge failure in the following cases.
 - 1) When the power is normal.
 - 2) From the point in which the vehicle speed reaches 4.9 mph(8 km/h) after HECU power on.

COUNTERMEASURES IN FAIL

1. Turn the system down and perform the following actions and wait for HECU power OFF.
2. Turn the valve relay off.
3. Stop the control during the operation and do not execute any until the normal condition recovers.

WARNING LAMP ON

1. ABS warning lamp turns on when ABS is fail.
2. TCS warning lamp turns on when TCS is fail.
3. ESP operation lamp turns on and TCS OFF warning lamp blinks when ESP is fail.

When power voltage and valve relay voltage are abnormal, input/output related failure judgment is not made.

STEERING WHEEL ANGLE SPEED SENSOR

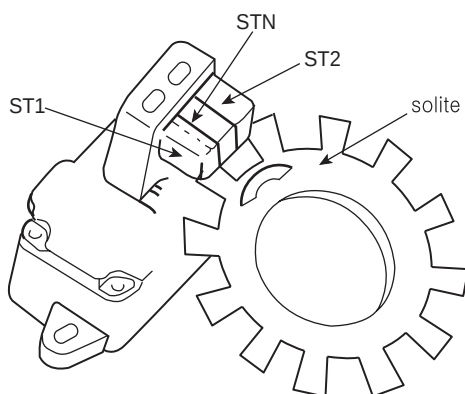
DESCRIPTION EF0201A5

The steering angle speed sensor detects the angle of the steering wheel in order to which direction a user chooses. The sensor is detached on the MPS(Mutil-Function Switch) under the steering wheel.

OPERATION

The split of the steering angle sensor detects a steering angle of the steering wheel by a ON/OFF pulse caused by whether or not the LED lights go through the hole of the split, rotating as the steering wheel revolves. There are three LEDs, two(ST1, ST2) for detecting a steering direction, and the other for the neutral position.

The HECU calculates the steering angle by the pulse from the steering angle sensor.



LJIF501S

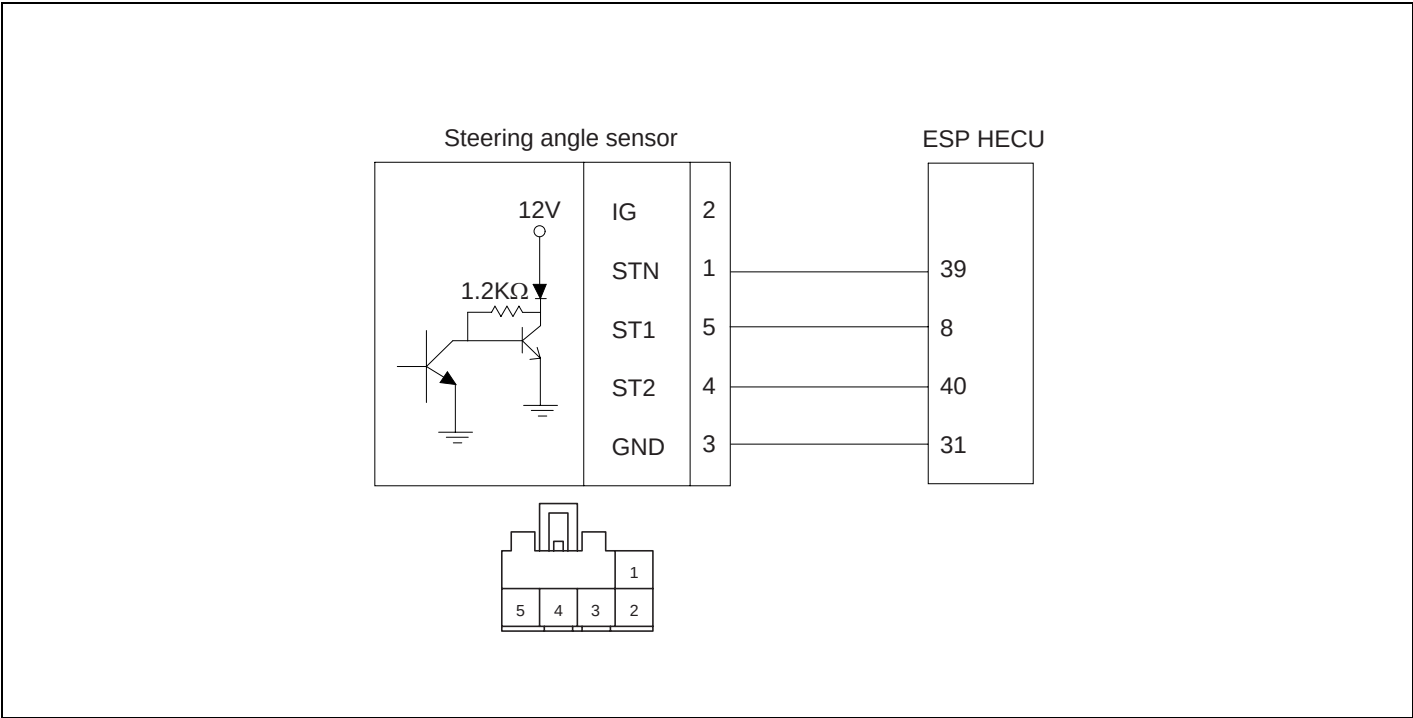
ESP(ELECTRONIC STABILITY PROGRAM) SYSTEM

BR -161

SPECIFICATIONS

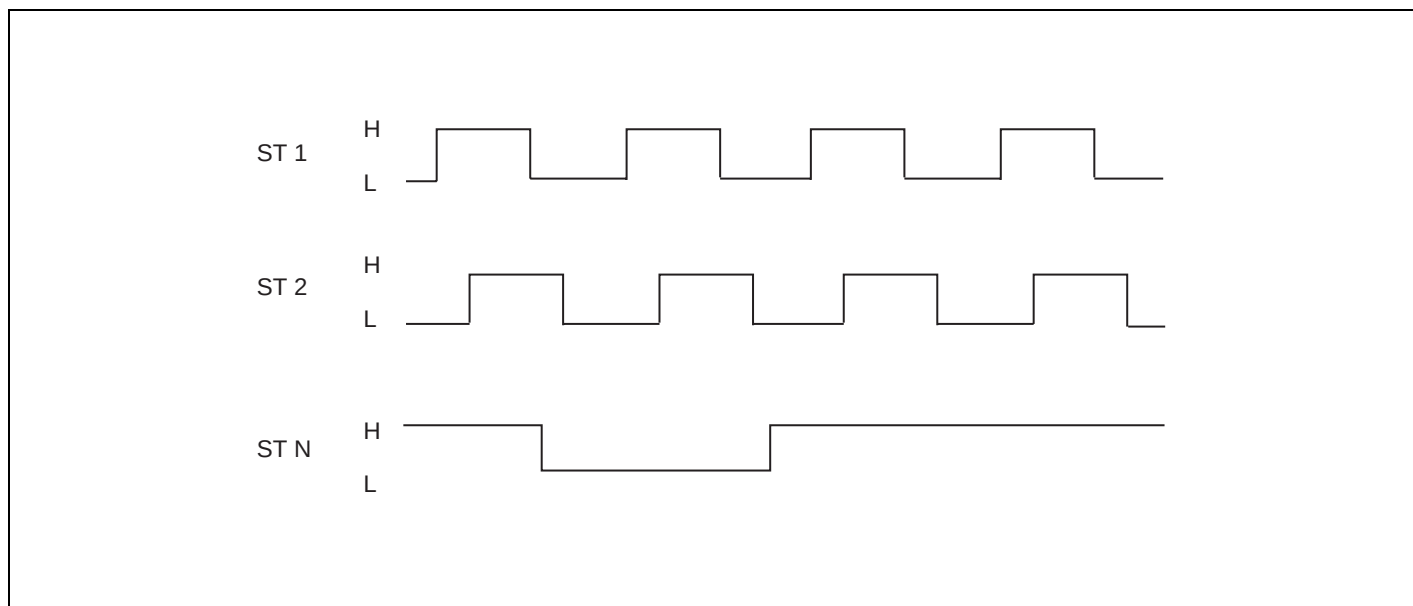
Item	Specification
Operating Voltage	9V~16V
Operating temperature	-30°C~75°C
Current consumption	Max. 100mA
Pulse duty	50±10%
Pulse width	8°/1pulse
Voltage(HIGH)	3.0V~4.1V
Voltage(LOW)	1.3V~2.0V
Steering angle velocity	Max 1500°/sec

CIRCUIT DIAGRAM ECEEE5F



LJIF502B

OUTPUT CHARACTERISTIC



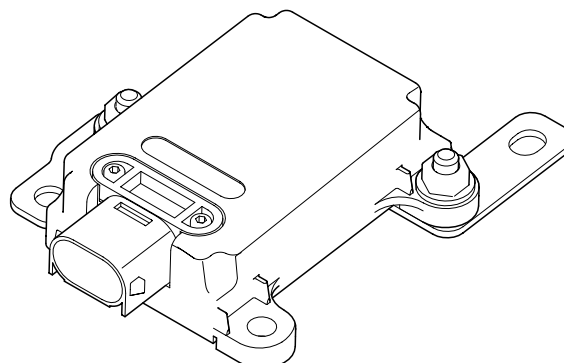
ARCD204A

No.	INPUT		OUTPUT	Steering direction	Remark
1	ST1	L	L	Right	
	ST2	L	H		
	ST1	L	H	Left	
	ST2	L	L		
2	ST1	L	L	Left	
	ST1	H	L		
	ST1	L	H	Right	
	ST2	H	H		
3	ST1	H	H	Left	
	ST2	L	H		
	ST1	H	L	Right	
	ST2	L	L		
4	ST1	H	H	Right	
	ST2	H	L		
	ST1	H	L	Left	
	ST2	H	H		

YAW-RATE SENSOR & G-SENSOR

DESCRIPTION E58D9E1C

1. The yaw-rate & lateral G sensor is applied for the ESP system.
2. The yaw-rate is the angular velocity, when a vehicle turns a corner, and the lateral G is the acceleration to move a vehicle out of the way when cornering.

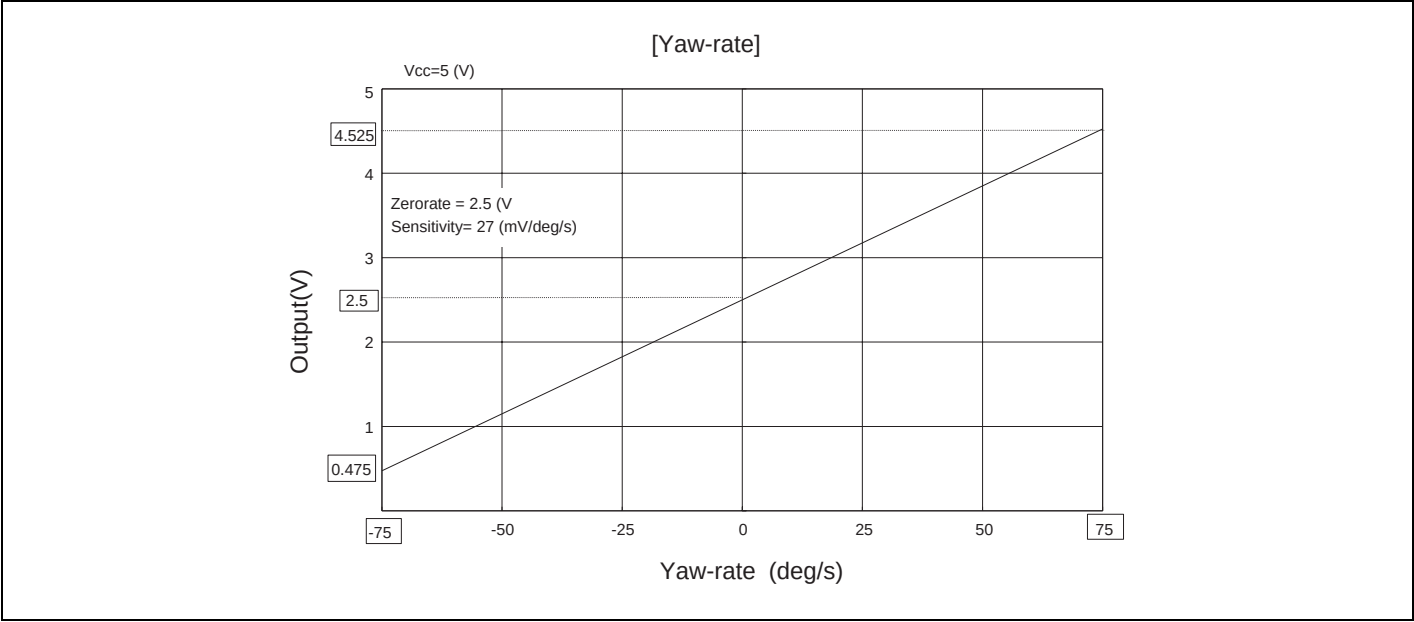


KJQE380A

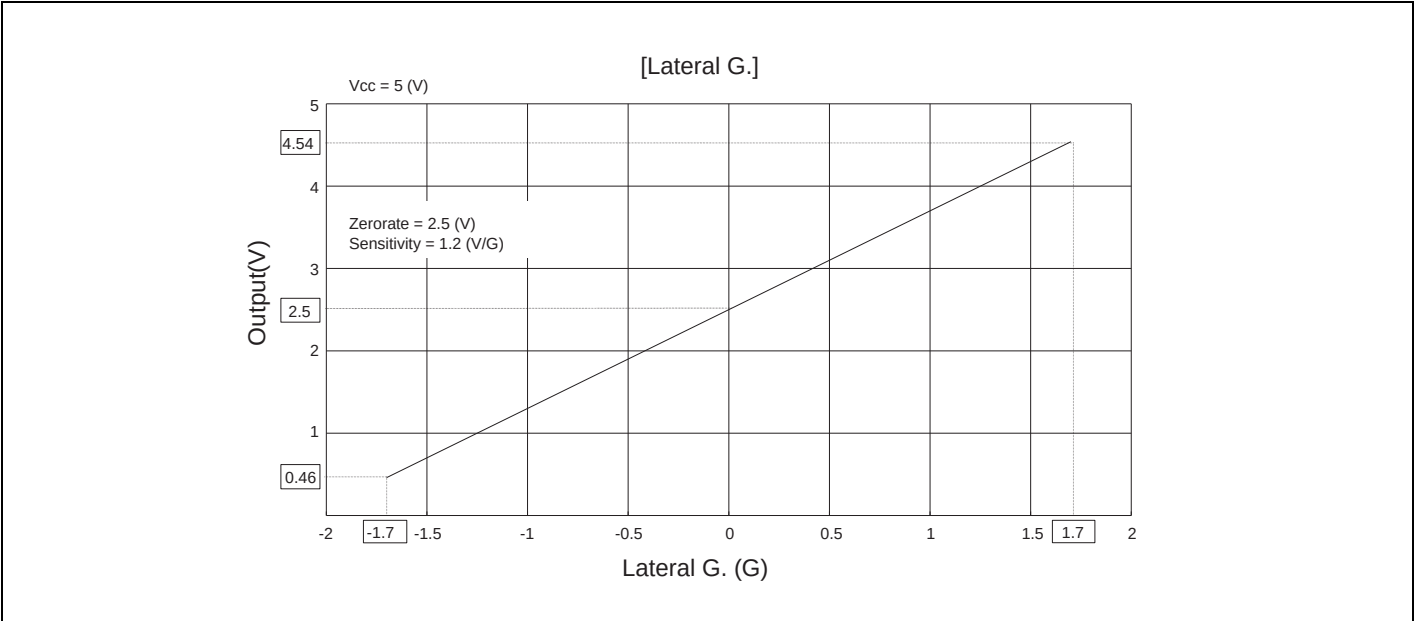
SPECIFICATIONS

ITEM		SPECIFICATION	REMARK
Operating voltage		4.75 ~ 5.25V	
Current consumption		less than 65mA	
Output voltage range		0.5 ~4.5V	
Operating temperature		-40 ~85°C	
Yaw-rate sensor	Measurement range	-75 ~ +75°/sec	
	Output voltage range	0.5 ~ 4.5V	
	Sensitivity	26.67mV(°/sec.)	
	Zero rate output	2.5V	
	Frequency response	18~22Hz	
Lateral G. sensor	Measurement range	-1.5 ~ +1.5g	
	Output voltage range	0.5 ~ 4.5 V	
	Sensitivity	0.136V/g	
	Zero rate output	2.5V	
	Frequency response	50Hz	

OUTPUT CHARACTERISTIC

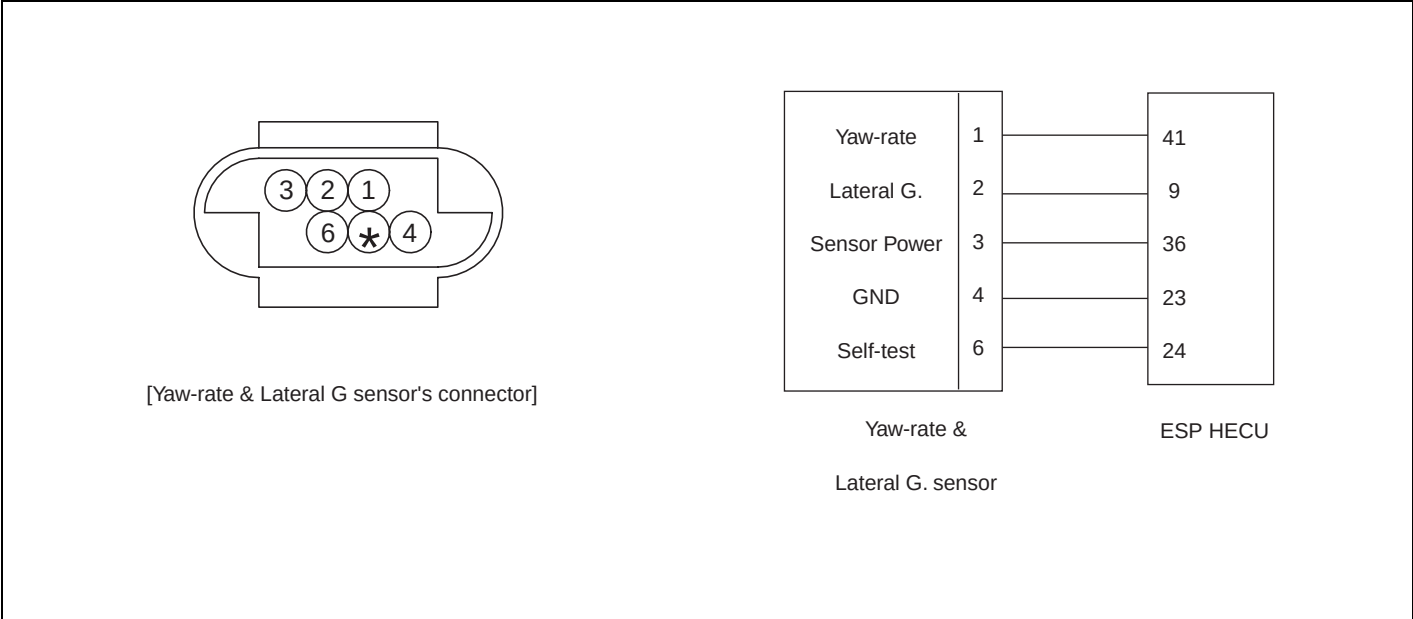


EJQE206A



EJQE206B

EXTERNAL DIAGRAM



LJIF502C

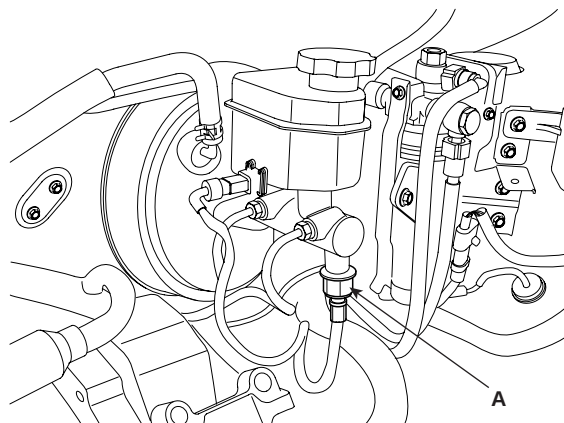
MASTER CYLINDER PRESSURE SENSOR

DESCRIPTION EECF19B7

The pressure sensor(A) is connected to the master cylinder, when ESP is on operation, detecting the brake pressure in order to sense the user's will to brake a vehicle.

The pressure sensor(A) consists of two ceramic disks, one is fixed and the other movable, so that changes the distance of the two disks.

(Max. measurable pressure is 200bar.)

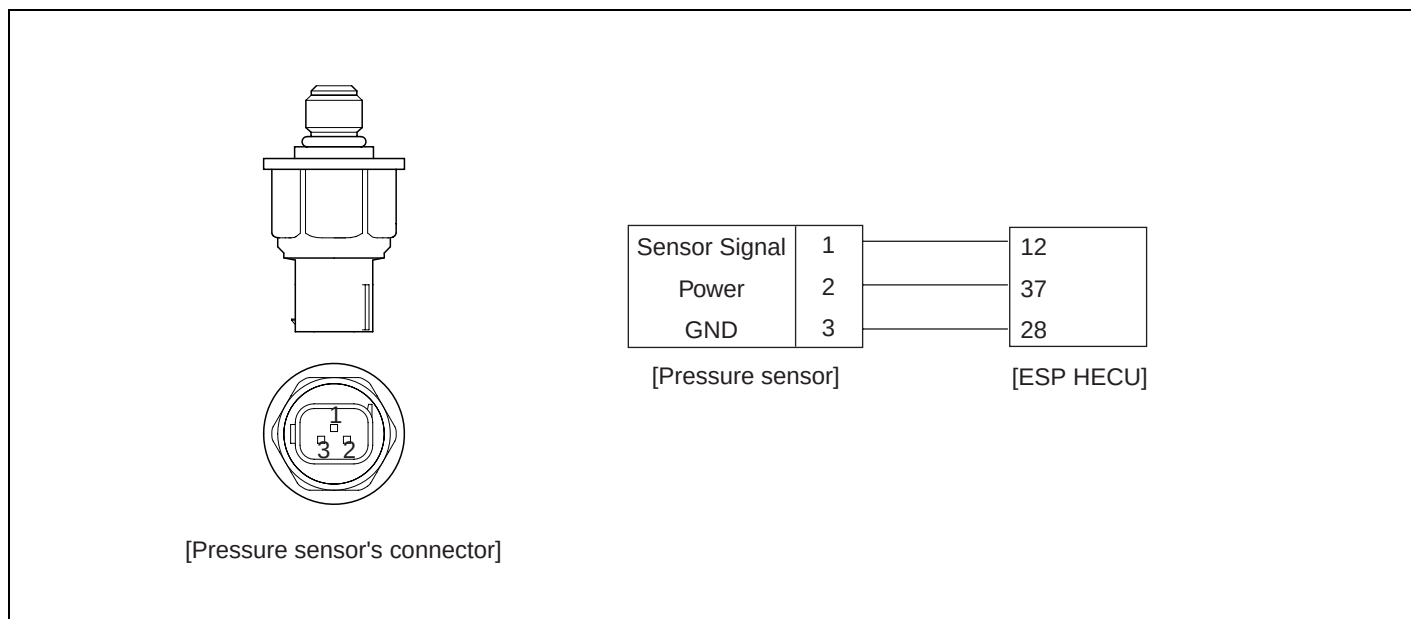


KJQE710E

SPECIFICATIONS

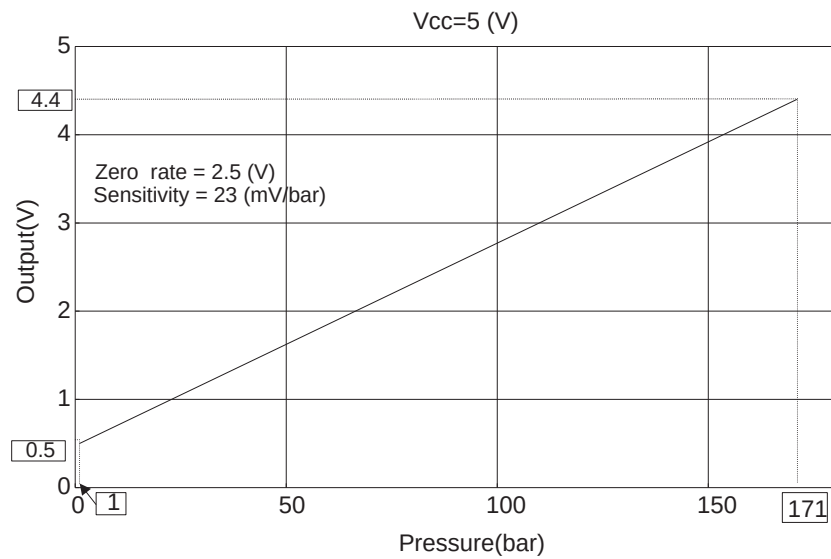
Item	Specification	Remark
Supply voltage	4.75V ~ 5.25V	
Supply current	less than 15mA	
Operating temperature	-40°C ~ 125°C	
Measurement pressure range	0 ~ 200bar	
Max. pressure limit	350bar	
Zero rate output	0.5V	
Output range	0.5 ~ 4.4V	

CIRCUIT DIAGRAM



LJIF502D

OUTPUT CHARACTERISTIC



EJQE206C

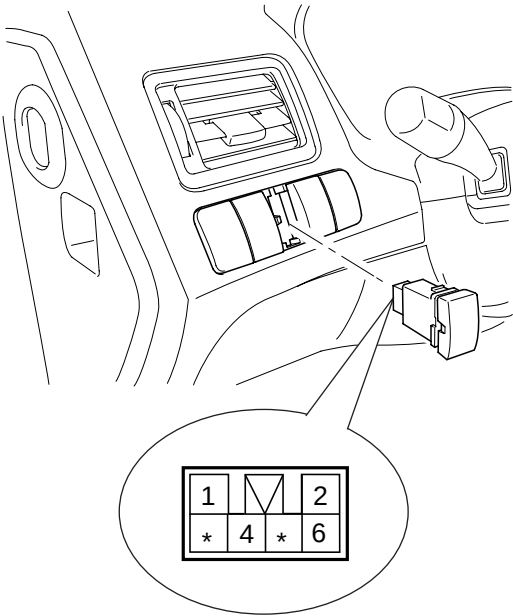
ESP SWITCH

DESCRIPTION E5159ABB

- 1. The ESP OFF switch is for the user to turn off the ESP system.
- 2. The ESP OFF lamp is on when ESP OFF switch is engaged.

INSPECTION E3FD2A1B

- 1. Remove the ESP OFF switch from the switch panel on the crushpad of the driver's side.



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- 2. Check the continuity between the switch terminals as the ESP OFF switch is engaged.

Terminal Function	1	4	6	2
ON	○	○	○	○
OFF			○	○

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